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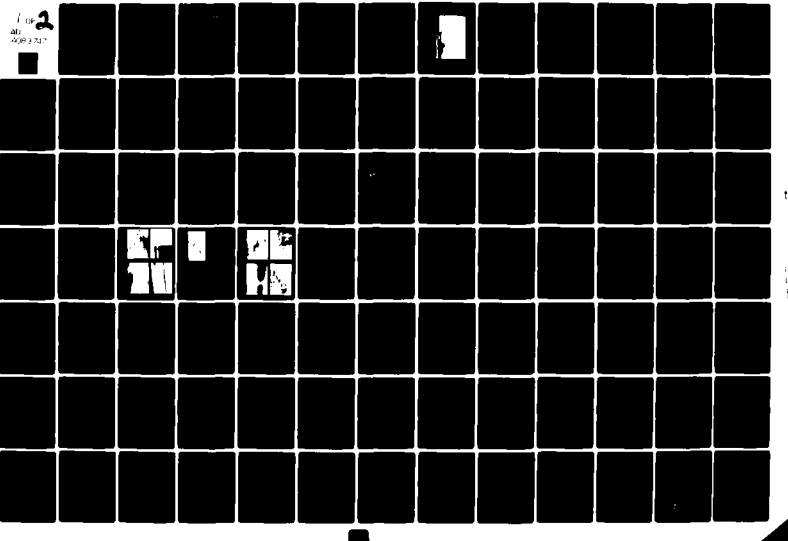

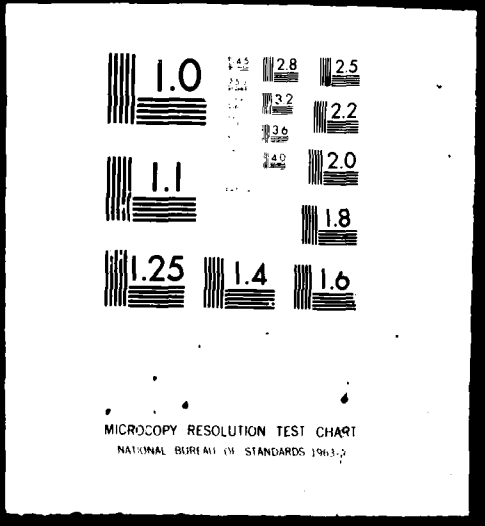

SUSQUEHANNA RIVER BASIN

KEHLY RUN, SCHUYLKILL COUNTY

PENNSYLVANIA

KEHLY RUN DAM NO. 3

NDS ID NO. PA-657

DER ID NO. 54-17

SHENANDOAH MUNICIPAL AUTHORITY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

Prepared By

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG, PENNSYLVANIA
15931

FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND
21203

MARCH 1980

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R. Jeffrey Kimball

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in detemining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM INSPECTION REPORT

NAME OF DAM	Kehly Run Dam No. 3
STATE LOCATED	Pennsylvania
COUNTY LOCATED	Schuylkill
STREAM	Kehly Run
DATE OF INSPECTION	November 7 and 16, 1979

ASSESSMENT

The assessment of Kehly Run Dam No. 3 is based upon visual observations made at the time of inspection, review of available records and data, hydraulic and hydrologic computations and past operational performance.

Kehly Run Dam No. 3 appears to be in fair condition. Several areas of "possible past instability" are apparent on the downstream slope. In addition, extensive seepage areas have been reported in the past but may be obscurred by the tailwater. Maintenance of the dam and operating facilities is considered poor.

Kehly Run Dam No. 3 is a high hazard-small size dam. The spillway design flood is the PMF (probable maximum flood). The spillway and reservoir are capable of controlling approximately 17% of the PMF without overtopping the embankment. Based on criteria established by the Corps of Engineers the spillway is termed inadequate, but not seriously inadequate.

The following recommendations and remedial measures should be instituted immediately.

1. A detailed hydrologic and hydraulic study should be conducted by a professional engineer knowledgeable in dam design to develop plans to increase spillway capacity. The exit channel and spillway wingwall should be evaluated to determine whether improvements are required. Many of the reservoirs in the Kehly Run system do not control the PMF, thus all spillways in the system should be studied and upgraded because of the severe consequence of failure of reservoirs in series and the location of the Borough of Shenandoah downstream.

2. The trees and large vegetation on embankment slopes and in the spillway should be cleared at the direction of a professional engineer knowledgeable in the design and construction of dams.

3. Some means of positive closure of the drainline should be developed in case of emergencies.

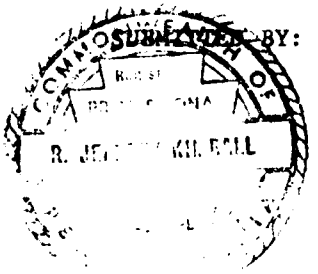
4. Exercise and lubricate all valves on a regular basis.

5. A detailed study should be conducted by a registered professional engineer knowledgeable in earth dams to evaluate the seepage, possible slope instability and source of discharge from the swimming pool on the stability of the structure.

6. A warning system should be developed to warn downstream residents of large spillway discharges or imminent failure of the dam.

7. A safety inspection program should be implemented with inspections at regular intervals by qualified personnel.

8. A subsidence investigation should be conducted by the owner or his engineer to determine the effects of past and present mining beneath the reservoir.



SUBMITTED BY:

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS AND ARCHITECTS

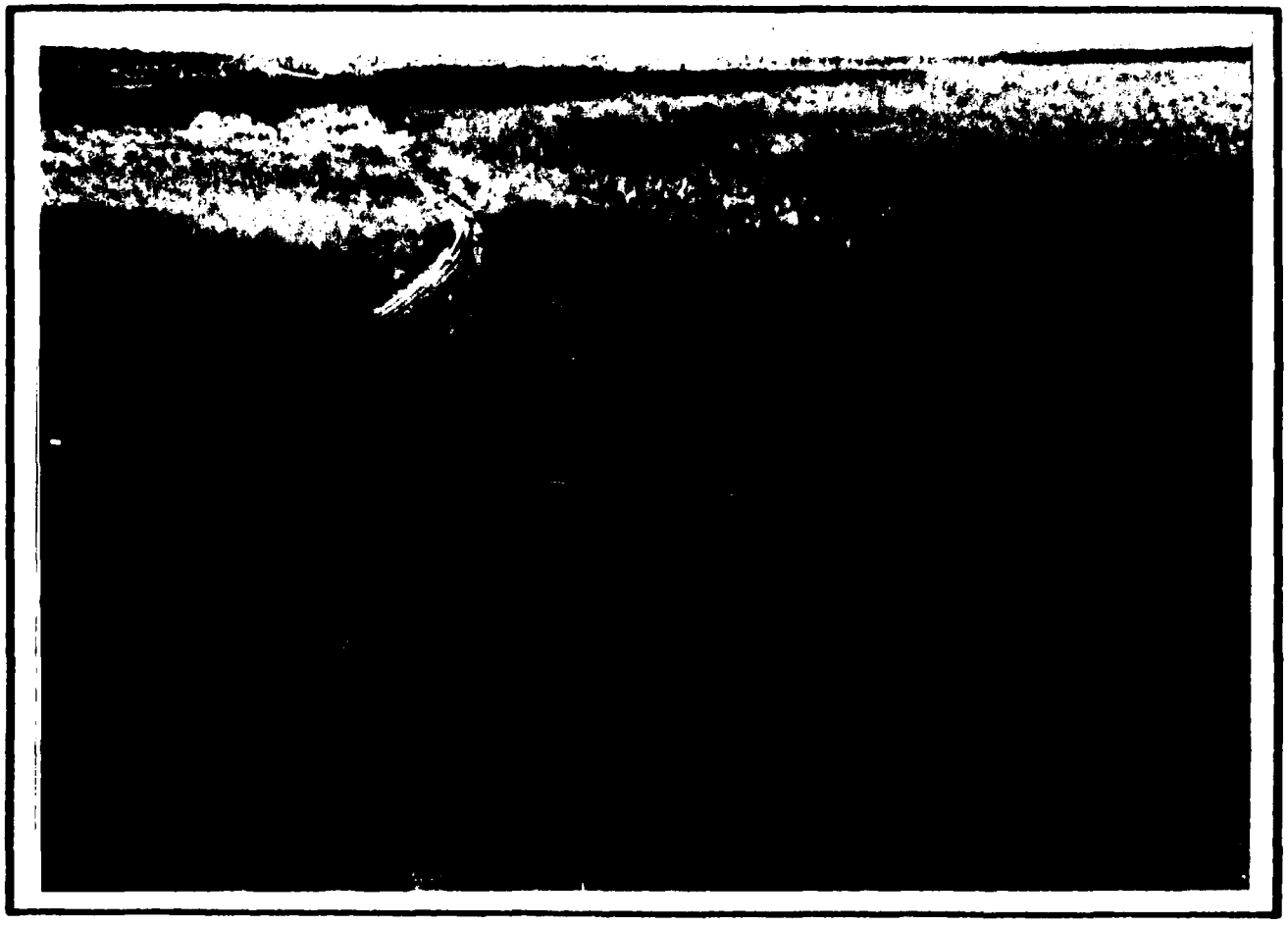
March 18, 1980
Date

R Jeffrey Kimball
R. Jeffrey Kimball, P.E.

APPROVED BY:

25 March 1980
Date

James W Peck
JAMES W. PECK
Colonel, Corps of Engineers
District Engineer



Overview of Kehly Run Dam No. 3. Downstream of Kehly Run Dam No. 3 is the swimming pool (formerly Kehly Run Dam No. 2). Note upstream dams (Kehly Run Dam No.'s 4, 5, and 6) in upper left corner.

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APPENDICES

PHASE I
NATIONAL DAM INSPECTION PROGRAM
KEHLY RUN DAM NO. 3
NDI. I.D. NO. PA 657
DER I.D. NO. 54-17

SECTION 1
PROJECT INFORMATION

1.1 General.

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Kehly Run Dam No. 3 is an earth and rockfill dam 442 feet long and approximately 33 feet high. The upstream slope is 1H:1V and covered with hand placed riprap. The downstream slope is 1.5H:1V and covered with rock rubble. The reservoir drain consists of a 10" cast iron pipe under the embankment.

The spillway is an open cut channel located on the left abutment. A stone masonry wall forms the junction between the spillway and the embankment. The left abutment hillside forms the left portion of the spillway. The spillway crest has a total length of 35 feet and has an irregular bottom. The spillway discharge channel winds along the left abutment and is confined by a stone rubble dike.

Immediately downtream of Kehly Run Dam No. 3 is a swimming pool which forms tailwater on the dam. This swimming pool is formerly Kehly Run Dam No. 2. Upstream of Kehly Run Dam No. 3 are three reservoirs (Kehly Run Dams No. 4, 5, 6).

b. Location. The dam is located on Kehly Run, one-half mile north of Shenandoah, Schuylkill County, Pennsylvania. Kehly Run Dam No. 3 can be located on the Shenandoah, U.S.G.S. 7.5 minute quadrangle.

c. Size Classification. Kehly Run Dam No. 3 is a small size structure (33 feet high, 40 acre-feet).

d. Hazard Classification. Kehly Run Dam No. 3 is a high hazard dam. Downstream conditions indicate that loss of more than a few lives is probable should the structure fail (See Section 3.1e).

e. Ownership. Kehly Run Dam No. 3 is owned by The Shenandoah Municipal Authority. Correspondence should be addressed to:

Shenandoah Municipal Authority
26 West Lloyd Street
Shenandoah, PA 17976
Attention: Charles Dallazia, Manager
717-462-1904

f. Purpose of Dam. Kehly Run Dam No. 3 is used for water supply.

g. Design and Construction History. The dam was built in approximately 1872. No information is available on the design or construction of the original dam. No drawings are available on the dam. The spillway was originally located in the center portion of the embankment but was moved to the left abutment prior to 1920.

h. Normal Operating Procedure. The reservoir is maintained at the spillway crest elevation 1495.0. Excess inflow is discharged over the spillway crest. Water is drawn off Kehly Run Dam No. 3 through the outlet works into the water system. It is believed that the outlet works pipe is used as the reservoir drain.

1.3 Pertinent Data.

a. Drainage Area. 1.01 square miles

b. Discharge at Dam Site (cfs).

Maximum known flood at dam site	Unknown
Spillway capacity at top of dam	490
Reservoir drain	Unknown

c. Elevation (U.S.G.S. Datum) (feet). - Field survey based on pool elevation 1495 shown on USGS 7.5 minute quadrangle.

Top of dam - low point	1497.6
Top of dam - design height	Unknown
Maximum pool - PMF	1498.9
Full flood control pool	Not applicable
Normal pool	1495.0
Spillway crest	1495.0

Streambed at centerline of dam	1465.2
Tailwater on day of inspection	1464.1
Toe of dam	1465.2

d. Reservoir (feet).

Length of maximum pool (PMF)	600
Length of normal pool	400

e. Storage (acre-feet).

Normal pool	33
Top of dam	40

f. Reservoir Surface (acres).

Top of dam	2.7
Normal pool	2.4
Spillway crest	2.4

g. Dam.

Type	Earth and rockfill
Length	442'
Height	33'
Top width	16'
Side slopes - upstream	1H:1V
- downstream	1.5H:1V
Zoning	Unknown
Impervious core	Unknown
Cutoff	Unknown

h. Reservoir Drain.

Type	10" CIP
Length	Approximately 110'
Closure	Valve at toe
Access	None
Regulating facilities	Valve at toe

i. Spillway.

Type	Open cut channel
Weir Length	35'
Crest elevation	1495'
Upstream channel	Unrestricted
Downstream channel	Narrow open channel

SECTION 2
ENGINEERING DATA

2.1 Design. Review of information in the files of the Commonwealth of Pennsylvania, Department of Environmental Resources revealed that inspection reports, permits, photographs and correspondence were available for review. No design reports or original design drawings or construction data was available. The data that was available was reviewed for this study.

2.2 Construction. No data is available on construction of the dam.

2.3 Operation. No operating records are maintained.

2.4 Evaluation.

a. Availability. Engineering data were provided by PennDER, Bureau of Dams and Waterway Management and the owner. The manager of the Municipal Authority was interviewed to obtain data on operation and maintenance of the dam. The owner did not provide any information on past deep mining activities in the area of the dam and reservoir.

b. Adequacy. A detailed analysis cannot be made because of the lack of detailed design information or drawings. This Phase I Report is based upon available data, visual inspection, and a hydrologic and hydraulic analysis.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The onsite inspection of Kehly Run Dam No. 3 was conducted by personnel of L. Robert Kimball and Associates on November 7 and 16, 1979. The inspection consisted of:

1. Visual inspection of the retaining structure, abutments and toe.
2. Examination of the spillway facilities, exposed portion of any outlet works and other appurtenant works.
3. Observations affecting the runoff potential of the drainage basin.
4. Evaluation of the downstream area hazard potential.

b. Dam. The dam appears to be in fair condition. From a brief survey conducted during the inspection, it was noted that a low spot was present adjacent to the spillway. The upstream slope was measured to be 1H:1V and covered with hand placed masonry. The downstream slope was measured to be 1.5H:1V and covered with stone rubble. The crest width is 16 feet. The upstream slope was covered with small trees and brush and the downstream slope was covered with larger trees and brush. The downstream slope showed two areas (one located near the center of the embankment, the other located near the left abutment) that have either had new material added or showed signs of possible slope movement. A small amount of seepage was present along the left abutment. This seepage was partially obscurred by the presence of large boulders dumped on this abutment. The swimming pool located at the toe of dam (formerly a dam named Kehly Run Dam No. 2) may have partially obscured this seepage and obscured viewing the toe of dam.

c. Appurtenant Structures. The open cut spillway is located on the left abutment. The junction of the spillway and the embankment is formed by a masonry wall. This masonry wall is in need of repair. The weir has an irregular crest caused by the severe deterioration of the concrete. The weir is 19 feet long at elevation 1495.0. The weir gains an additional 16 feet of width (total 35 feet) by gently sloping upward to meet the natural hillside. The spillway exit channel is narrow and very irregular. The channel follows the left abutment hillside and is formed by a stone rubble dike (See photographs, Appendix C).

The 10" cast iron pipe outlet works was not observed during the inspection. The valve to control flow through the outlet works is below the toe of dam. No upstream shutoff is provided.

d. Reservoir Area. The watershed is covered mostly with woodland. The reservoir slopes are moderately steep but are not susceptible to landslides which would affect the storage volume of the reservoir or overtopping of the dam by displacing water.

e. Downstream Channel. The channel downstream of Kehly Run Dam No. 3 is narrow for approximately 1800 feet until it fans out into the Borough of Shenandoah.

3.2 Evaluation. In general, the embankment and appurtenant structures appear to be in fair condition but poorly maintained.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures. The reservoir is maintained at the spillway crest elevation 1495.0. The valve in the outlet works remains open so that water enters the water system. The excess inflow discharges over the spillway crest. The valve is reportedly operated on a regular basis.

4.2 Maintenance of the Dam. No planned maintenance schedule exists. Maintenance of the dam is performed by the Municipal Authority staff. Maintenance of the dam is considered poor.

4.3 Maintenance of Operating Facilities. Maintenance of the spillway and outlet works is considered poor. The valve on the outlet works is reportedly operated regularly.

4.4 Warning System in Effect. There is no warning system in effect to warn downstream residents of large spillway discharges or imminent failure of the dam.

4.5 Evaluation. Maintenance of the dam and operating facilities is considered poor. There is no system in effect to warn downstream residents of large spillway discharges or failure of the dam.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features.

a. Design Data. No calculations or design data pertaining to hydrology were available.

b. Experience Data. No rainfall, runoff or reservoir level data were available. The spillway has reportedly functioned adequately in the past.

c. Visual Observations. The spillway appeared to be in poor condition. The spillway crest is badly deteriorated, sedimentation and debris has destroyed the original overflow channel. The discharge channel is narrow and flow is partially restricted by occassional large boulders.

A low spot was noted on the dam embankment adjacent to the right spillway wingwall. This area could easily be filled to increase the top of dam elevation.

d. Overtopping Potential. Overtopping potential was investigated through the development of the probable maximum flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway.

The Corps of Engineers, Baltimore District, has directed that the HEC-1 Dam Safety Version systemized computer program be utilized. The program was prepared by the Hydrologic Engineering Center (HEC), U.S. Army Corps of Engineers, Davis, California, July, 1978. The major methodologies or key input data for this program are discussed briefly in Appendix D.

5.2 Evaluation Assumptions. To enable us to complete the hydraulic and hydrologic analysis for this structure, it was necessary to make the following assumptions.

1. The pool elevation in the reservoir prior to the storm is 1495 feet.

2. For the overtoppping analysis a top of dam elevation of 1497.6 feet (low spot) was assumed for the entire length of the crest of 442 feet. Field survey measurements taken during the inspection indicate that the top of dam varies from 1497.6 feet to 1498.6 feet.

3. For the dam breach analysis it was assumed that dam failure would begin when the water level in the reservoir reached elevation 1497.9 or 0.30 feet over the top of the dam.

4. The flood was routed through all upstream reservoirs.

5.3 Summary of Overtopping Analysis. Complete summary sheets for the computer output are presented in Appendix D.

Peak inflow (PMF)	2764 cfs
Spillway capacity	446 cfs

a. Spillway Adequacy Rating. The Spillway Design Flood (SDF) for this dam is the PMF. The SDF is based on the hazard and size classification of the dam. Based on the following definition provided by the Corps of Engineers, the spillway is rated as inadequate as a result of our hydrologic analysis.

> Inadequate - All high hazard dams which do not pass the SDF (PMF), but where failure due to overtopping does not significantly increase the hazard potential for loss of life downstream.

The spillway and reservoir are capable of controlling approximately 17% of the PMF without overtopping the dam (based on low spot).

5.4 Summary of Dam Breach Analysis. As the subject dam cannot satisfactorily pass 50% of the PMF (based on our analyses) it was necessary to perform a breach analysis and downstream routing of the flood wave. This analyses determines the degree of increased flooding due to dam failure.

The water level in the reservoir at the time of dam failure was assumed to be at 1497.9 feet (0.30 feet over the top of dam low spot) based on the evaluating engineers judgement. The 30% PMF was routed through the reservoir and downstream.

The flood wave was routed downstream with and without embankment failure conditions considered. The flood was not routed through the swimming pool because of its small size.

Results of the Dam Breach analysis indicate that downstream flooding is not significantly increased. Since flooding downstream is not significantly increased due to dam failure, the spillway is not considered seriously inadequate. Therefore, this spillway is rated as "inadequate".

Note: Future development within the watershed, at the dam, or downstream may change the characeristics and assumptions made for this study and different results are likely. Future development downstream may also greatly increase the potential for loss of life due to failure of the structure.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. Two locations on the downstream embankment slope showed possible signs of instability. These two areas appear as if some of the rock rubble has recently moved downslope. These areas are not vegetated. These areas are located approximately 160 feet from the right abutment and adjacent to the spillway.

A very small amount of seepage was present approximately 150 feet to the right of the spillway at the toe of dam. It is reported in the correspondence that Kehly Run Dam No. 2 (swimming pool) was constructed to collect seepage. However, because of the swimming pool and the presence of large rock boulders on the left abutment this seepage is obscured. The swimming pool at the toe of dam may be obscuring the presence of a large quantity of seepage. The outflow from the swimming pool is several hundred gallons per minute. Past history indicates a large amount of seepage near the toe of dam.

b. Design and Construction Data. No stability analyses are on record for this dam. No data on the design or construction is available.

c. Operating Records. No operating records are maintained.

d. Post Construction Changes. No post construction changes are known other than reconstruction of the spillway on the left abutment and construction of Kehly Run Dam No. 2, downstream of Kehly Run Dam No. 3.

e. Seismic Stability. The dam is located in seismic zone 1. No seismic stability analyses has been performed. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected loading.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The dam appears to be in fair condition. There is evidence that slow movement is taking place or has recently taken place on portions of the downstream slope. A small amount of seepage was in evidence during the inspection. In addition, past inspections report a considerable amount of seepage at the toe of dam prior to construction of Kehly Run Dam No. 2. The tailwater may be obscuring a high seepage rate. The visual observations, review of available information, hydrologic and hydraulic calculations and past operations and performance indicate that Kehly Run Dam No. 3's spillway is inadequate but not seriously inadequate. The spillway is capable of controlling 17% of the PMF without overtopping the earth embankment. No adequate stability analysis has been performed for this structure. The long term affect of the seepage is unknown.

b. Adequacy of Information. Detailed analyses of the structure cannot be made because of the lack of any design or construction data. This Phase I Report is based upon visual observations, review of available data, hydrologic and hydraulic calculations and past operations and performance.

c. Urgency. The recommendations suggested below should be implemented immediately.

d. Necessity for Further Investigation. To complete some of the recommendations/remedial measures outlined below, additional investigations are required.

7.2 Recommendations/Remedial Measures.

1. A detailed hydrologic and hydraulic study should be conducted by a professional engineer knowledgeable in dam design to develop plans to increase spillway capacity. The exit channel and spillway wingwall should be evaluated to determine whether improvements are required. Many of the reservoirs in the Kehly Run system do not control the PMF, thus all spillways in the system should be studied and upgraded because of the severe consequence of failure of reservoirs in series and the location of the Borough of Shenandoah downstream.

2. The trees and large vegetation on embankment slopes and in the spillway should be cleared at the direction of a professional engineer knowledgeable in the design and construction of dams.

3. Some means of positive closure of the drainline should be developed in case of emergencies.

4. Exercise and lubricate all valves on a regular basis.

5. A detailed study should be conducted by a registered professional engineer knowledgeable in earth dams to evaluate the seepage, possible slope instability and source of discharge from the swimming pool on the stability of the structure.

6. A warning system should be developed to warn downstream residents of large spillway discharges or imminent failure of the dam.

7. A safety inspection program should be implemented with inspections at regular intervals by qualified personnel.

8. A subsidence investigation should be conducted by the owner or his engineer to determine the effects of past and present mining beneath the reservoir.

APPENDIX A
CHECKLIST, VISUAL INSPECTION, PHASE I

CHECK LIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Kehly Run Dam No. 3 COUNTY Schuylkill STATE Pennsylvania ID# PA 657

TYPE OF DAM Earth and rockfill HAZARD CATEGORY High

DATE(s) INSPECTION Nov. 7 and 16, 1979 WEATHER Cloudy, warm TEMPERATURE 50°

POOL ELEVATION AT TIME OF INSPECTION 1495.0 M.S.L. TAILWATER AT TIME OF INSPECTION 1464.2 M.S.L.

INSPECTION PERSONNEL:

R. Jeffrey Kimball, P.E. - L. Robert Kimball and Associates

James T. Hockensmith - L. Robert Kimball and Associates

O.T. McConnell - L. Robert Kimball and Associates

James T. Hockensmith RECORDER

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None noted in embankment.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None noted.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Two areas, 150 feet from right abutment, and adjacent to spillway, appear to have had recent slope movement and recently placed material added.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Horizontal alignment appears to be good. Vertical, low spot on the spillway.	
RIPRAP FAILURES	None.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Small trees and brush on upstream slope. Trees and brush on downstream slope.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Appears to be good. Masonry wall at embankment -spillway contact in need of repair.	
ANY NOTICEABLE SEEPAGE	Minor amount of seepage noted at junction of left abutment and toe of dam. However, considerable amount of seepage may be present beneath the tail-water.	
STAFF GAUGE AND RECORDER	None.	
DRAINS	None.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	Not applicable.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Not applicable.	
DRAINS	Not applicable.	
WATER PASSAGES	Not applicable.	
FOUNDATION	Not applicable.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Not applicable.	
STRUCTURAL CRACKING	Not applicable.	
VERTICAL AND HORIZONTAL ALIGNMENT	Not applicable.	
MONOLITH JOINTS	Not applicable.	
CONSTRUCTION JOINTS	Not applicable.	
STAFF GAUGE OR RECORDER	Not applicable.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Outlet works unobserved during inspection.	
INTAKE STRUCTURE	Unobserved during inspection.	
OUTLET STRUCTURE	None.	
OUTLET CHANNEL	None.	
EMERGENCY GATE	Valve beyond toe of dam. Not operated during inspection.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Very irregular weir surface. Right wall of spillway shows considerable deterioration.	
APPROACH CHANNEL	Lake.	
DISCHARGE CHANNEL	Stone rubble dike forms the discharge channel.	
BRIDGE AND PIERS	None.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Not applicable.	
APPROACH CHANNEL	Not applicable.	
DISCHARGE CHANNEL	Not applicable.	
BRIDGE AND PIERS	Not applicable.	
GATES AND OPERATION EQUIPMENT	Not applicable.	

DOWNSTREAM CHANNEL

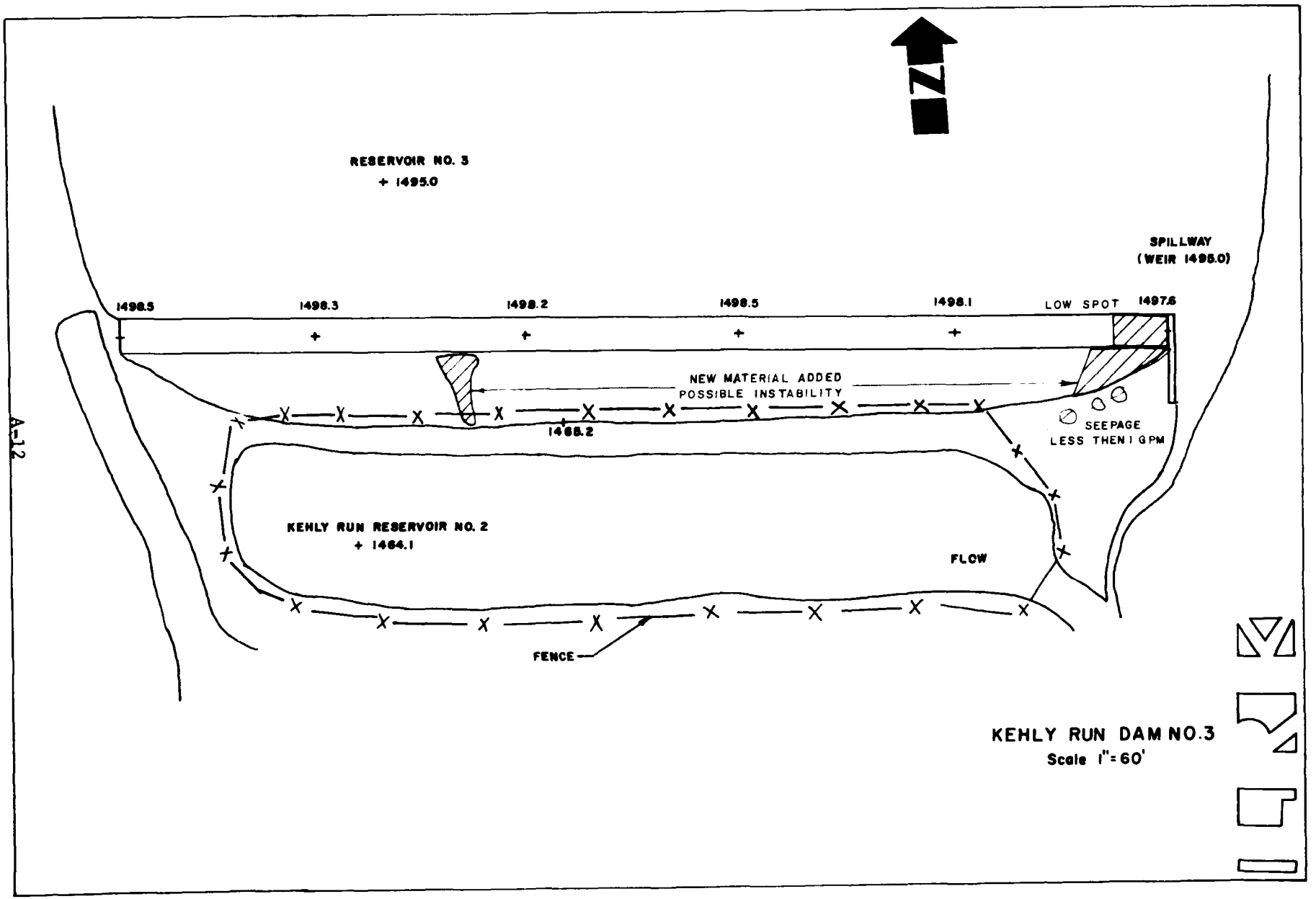
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Narrow confined channel.	
SLOPES	Appear to be stable.	
APPROXIMATE NO. OF HOMES AND POPULATION	Approximately 400 homes - 1600 people.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Steep but appear to be stable.	
SEDIMENTATION	Does not appear to be excessive because of upstream reservoirs.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	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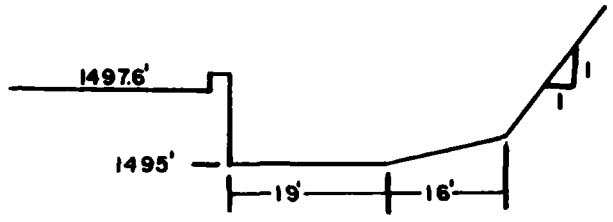
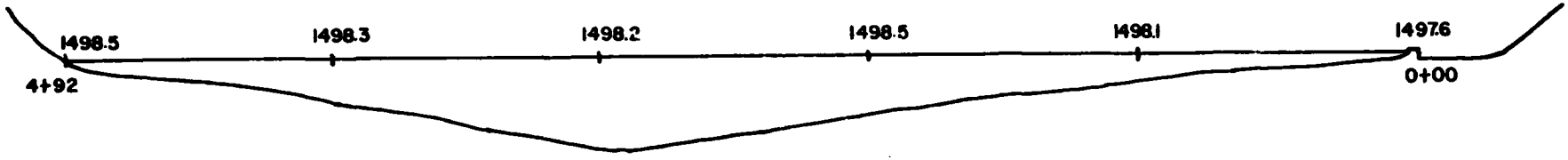
RESERVOIR NO. 3
+ 1495.0
SPILLWAY
(WEIR 1495.0)
1498.5
1498.3
1498.2
1498.5
1498.1
LOW SPOT
1497.6
NEW MATERIAL ADDED
POSSIBLE INSTABILITY
1498.2
SEEPAGE
LESS THEN 1 GPM
KEHLY RUN RESERVOIR NO. 2
+ 1464.1
FLOW
FENCE
KEHLY RUN DAM NO.3
Scale 1"=60'



SPILLWAY PROFILE

(Not to Scale)



PROFILE
LOOKING UPSTREAM

KEHLY RUN DAM NO. 3

Scale 1"= 60'

APPENDIX B
CHECKLIST, ENGINEERING DATA, DESIGN, CONSTRUCTION, OPERATION, PHASE I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Kehly Run Dam No. 3

ID# PA 657

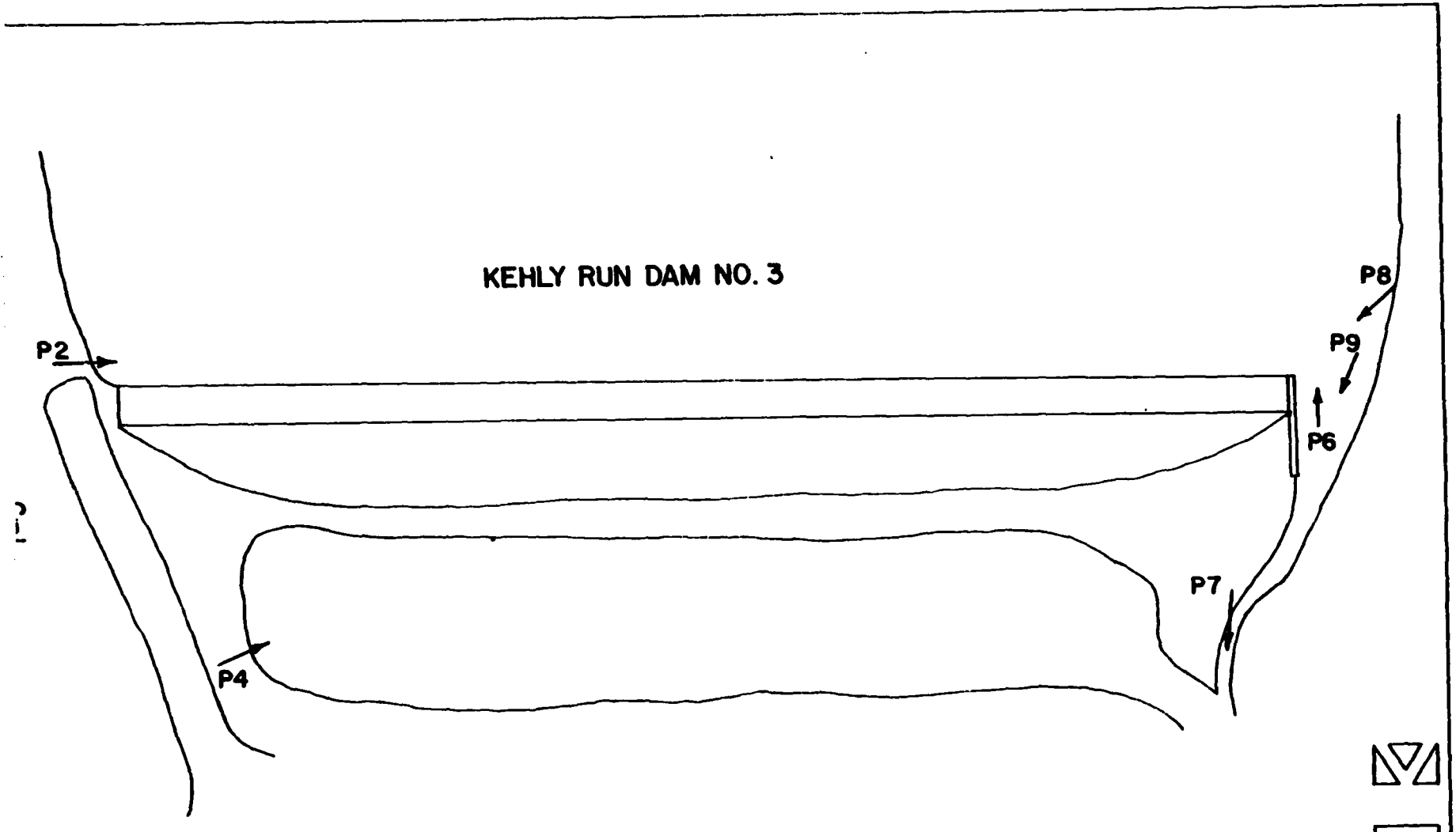
ITEM	REMARKS
AS-BUILT DRAWINGS	None.
REGIONAL VICINITY MAP	USGS quadrangle.
CONSTRUCTION HISTORY	None.
TYPICAL SECTIONS OF DAM	None.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS RAINFALL/RESERVOIR RECORDS	None. None. None. None. None.

ITEM	REMARKS
DESIGN REPORTS	None.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Unknown.
POST-CONSTRUCTION SURVEYS OF DAM	Unknown.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	Unknown.
HIGH POOL RECORDS	None.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Unknown.
MAINTENANCE OPERATION RECORDS	None.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	None.
OPERATING EQUIPMENT PLANS & DETAILS	None.

APPENDIX C
PHOTOGRAPHS



P – INDICATES PHOTO LOCATION

KEHLY RUN DAM NO. 3
PHOTO INDEX

KEHLY RUN DAM NO. 3

Photograph Descriptions

Sheet 1. Front

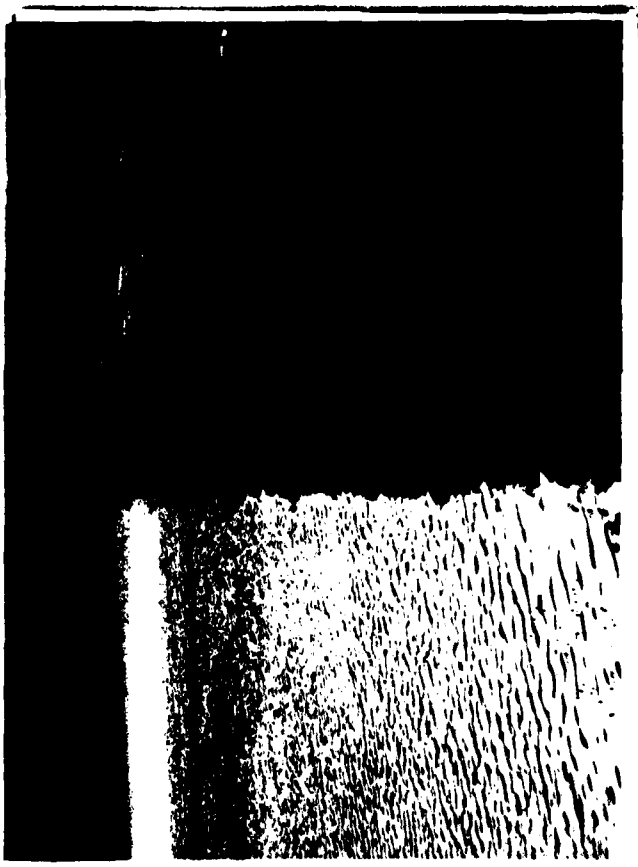
(1) Upper left - Spillway on Kehly Run Dam No. 4.
(2) Upper right - Upstream slope of Kehly Run Dam No. 3.
(3) Lower left - View of crest of Kehly Run Dam No. 4 (upstream dam). In background is downstream slope of Kehly Run Dam No. 5.
(4) Lower right - Downstream slope of Kehly Run Dam No. 3.

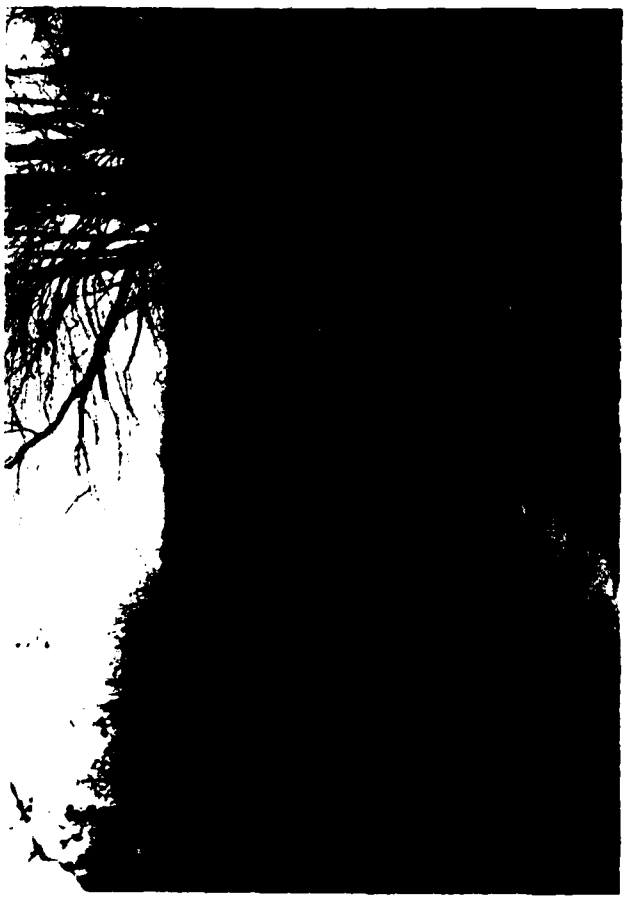
Sheet 1. Back

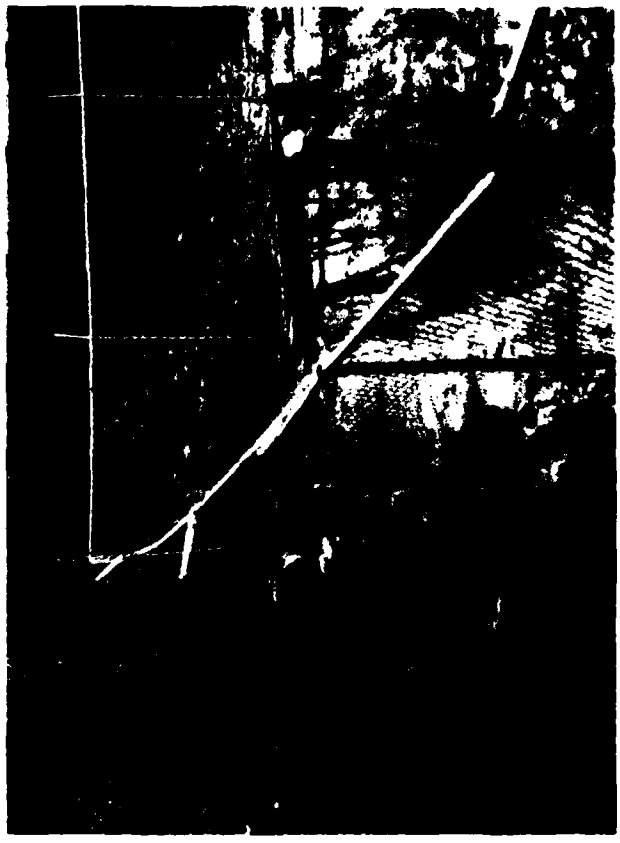
(5) Upper right - Downstream exposure (Shenandoah Borough). Coal refuse embankment in foreground.

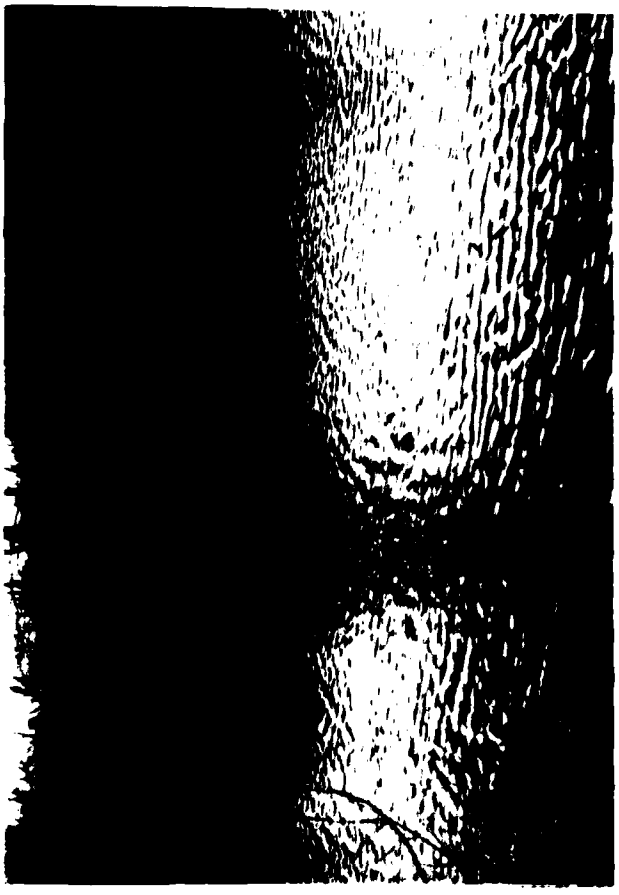
Sheet 2. Front

(6) Upper left - Spillway weir.
(7) Upper right - Spillway discharge channel along swimming pool.
(8) Lower left - Upstream slope and spillway entrance.
(9) Lower right - Spillway discharge channel.









APPENDIX D
HYDROLOGY AND HYDRAULICS

APPENDIX D
HYDROLOGY AND HYDRAULICS

Methodology. The dam overtopping and breach analyses were accomplished using the systemized computer program HEC-1 (Dam Safety Investigation), September, 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. A brief description of the methodology used in the analysis is presented below.

1. Precipitation. The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Report No. 40" prepared by the U.S. Weather Bureau.

The index rainfall is reduced from 10% to 20% depending on watershed size by utilization of what is termed the HOP Brook adjustment factor. Distribution of the total rainfall is made by the computer program using distribution methods developed by the Corps.

2. Inflow Hydrograph. The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing.

The unit hydrograph is developed using the Snyder method. This method requires calculation of several key parameters. The following list gives these parameters their definition and how they were obtained for these analysis.

Parameter	Definition	Where Obtained
Ct	Coefficient representing variations of watershed	From Corps of Engineers*
L	Length of main stream channel miles	From U.S.G.S. 7.5 minute topographic
Lca	Length on main stream to centroid of watershed	From U.S.G.S. 7.5 minute topographic
Cp	Peaking coefficient	From Corps of Engineers*
A	Watershed size	From U.S.G.S. 7.5 minute topographic

*Developed by the Corps of Engineers on a regional basis for Pennsylvania.

3. Routing. Reservoir routing is accomplished by using Modified Plus routing techniques where the flood hydrograph is routed through reservoir storage. Hydraulic capacities of the outlet works, spillways and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of the outlet works can either be calculated and input or sufficient dimensions input and the program will calculate an elevation discharge relationship.

Storage in the pool area is defined by an area - elevation relationship from which the computer calculates storage. Surface areas are either planimetered from available mapping or U.S.G.S. 7.5 minute series topographic maps or taken from reasonably accurate design data.

4. Dam Overtopping. Using given percentages of the PMF the computer program will calculate the percentage of the PMF which can be controlled by the reservoir and spillway without the dam overtopping.

5. Dam Breach and Downstream Routing. The computer program is equipped to determine the increase in downstream flooding due to failure of the dam caused by overtopping. This is accomplished by routing both the pre-failure peak flow and the peak flow through the breach (calculated by the computer with given input assumptions) at a given point in time and determining the water depth in the downstream channel. Channel cross-sections taken from U.S.G.S. 7.5 minute topographic maps were used in the downstream flood wave routing. Pre and post failure water depths are calculated at locations where cross-sections are input.

HYDROLOGY AND HYDRAULICS ANALYSIS
DATA BASE

NAME OF DAM: Kehly Run Dam No. 3

PROBABLE MAXIMUM PRECIPITATION (PMP) = 22.2 (1.005) = 22.3"

STATION	1	2	3	4
Station Description	Kehly No. 6	Kehly No. 5	Kehly No. 4	Kehly No. 3
Drainage Area (square miles)	0.29	0.11	0.04	0.57
Cumulative Drainage Area (square miles)	0.29	0.40	0.44	1.01
Adjustment of PMF for Drainage Area (%)(1)				
6 hours	117	117	117	117
12 hours	127	127	127	127
24 hours	136	136	136	136
48 hours	143	143	143	143
72 hours	145	145	145	145
Snyder Hydrograph Parameters				
Zone (2)	13	13	13	13
Cp (3)	0.50	0.50	0.50	0.50
Ct (3)	1.85	1.85	1.85	1.85
L (miles) (4)	0.40	0.40	0.19	0.85
Lca (miles) (4)	0.20	0.20	0.10	0.40
tp = Ct(LxLca) 0.3 hrs.	0.87	0.87	0.56	1.34
Spillway Data	Lt. Rt.			
Crest Length (ft)	9 26	39	10	35
Freeboard (ft)	3.5	3.1	3.0	2.6
Discharge Coefficient	3.1 C'=0.95	C'=0.95	C'=0.95	C'=0.95
Exponent	1.5 N/A	N/A	N/A	N/A

(1) Hydrometeorological Report 40 (Figure 1), U.S. Army Corps of Engineers, 1965.

(2) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's coefficients (C_p and C_t).

(3) Snyder's Coefficients.

(4) L=Length of longest water course from outlet to basin divide. L_{ca}=Length of water course from outlet to point opposite the centroid of drainage area.

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: D.A. =1.01 mi^2 Wooded Steep Slopes

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 33 ac.ft.

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 40 ac.ft.

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 1497.6 feet

SPILLWAY CREST:

a. Elevation 1495 feet
b. Type Trapezoidal
c. Width 35 feet - bottom
d. Length Channel approximately 200'
e. Location Spillover Left abutment
f. Number and Type of Gates None

OUTLET WORKS:

a. Type 10" CIP
b. Location Near original stream bottom
c. Entrance inverts Unknown
d. Exit inverts Unknown
e. Emergency draindown facilities 10" CIP

HYDROMETEOROLOGICAL GAUGES:

a. Type None
b. Location None
c. Records None

MAXIMUM NON-DAMAGING DISCHARGE: Unknown

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DAM NAME KEHLY RUN No. 3
I.D. NUMBER 54-17
SHEET NO. 1 OF 6
BY OTM DATE 1-23-80

LOSS RATE AND BASE FLOW PARAMETERS

AS RECOMMENDED BY CORPS OF ENGINEERS, BALTIMORE DISTRICT.

STRTL = 1 INCH
CNSTL = 0.05 IN/HR
STRTQ = 1.5 CFS/MI.^{2}
QRCSN = 0.05 (5% OF PEAK FLOW)
RTIOR = 2.0

ELEVATION-AREA-CAPACITY RELATIONSHIPS

FROM U.S.G.S. 7.5 MIN. QUAD, DER FILES AND FIELD INSPECTION DATA.

AT SPILLWAY CREST ELEVATION = 1495'
INITIAL STORAGE = 33.2 AC.FT.
POND SURFACE AREA = 2.4 ACRES

AT ELEV. 1500', AREA = 3.7 ACRES
AT ELEV. 1520', AREA = 6.4 ACRES

FROM CONIC METHOD FOR RESERVOIR VOLUME. FLOOD HYDROGRAPH PACKAGE (HEC-1), DAM SAFETY VERSION (USERS MANUAL).

$H = 3V/A$
$= 3(33.2)/2.4$
$= 99.6/2.4$
$= 41.5'$

ELEVATION WHERE AREA EQUALS ZERO:

$1495' - 41.5' = 1453.5'$

AREA	$A	0	2.4	3.7	6.4
ELEV.	$E	1453.5	1495	1500	1520

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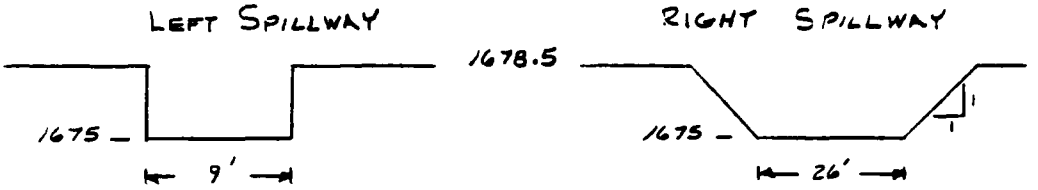
DAM NAME KEHLY RUN No. 3
I.D. NUMBER 54-17
SHEET NO. 2 OF 6
BY OTM DATE 2-26-80

DISCHARGE RATING CURVE (KEHLY RUN No. 6)



(NOT TO SCALE)

ELEV. (FT.)	LEFT SPILLWAY		RIGHT SPILLWAY		* DISCHARGE
	h_1 (FT)	Q_1 (cfs)	h_2 (FT)	Q_2 (cfs)	Q (cfs)
1675	0	0	0	0	0
1676	1	28	1	78	110
1677	2	79	2	227	310
1678	3	145	3	428	570
1678.5	3.5	183	3.5	545	730
1679	4	223	4	674	900
1680	5	312	5	965	1280
1685	10	882	10	3053	3940
1690	15	1621	15	6213	7830

* VALUES ROUNDED TO NEAREST 10 cfs.

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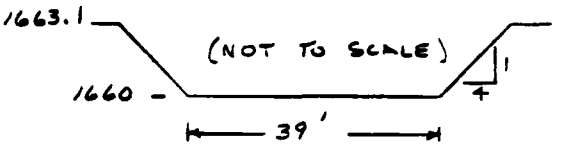
DAM NAME KEHLY RUN NO. 3
I.D. NUMBER 54-17
SHEET NO. 3 OF 6
BY OTM DATE 2-26-80

DISCHARGE RATING CURVE (KEHLY RUN NO. 5)

ELEV. (FT.)	hp (FT)	*Q (cfs)
1660	0	0
1660.5	.5	40
1661	1	120
1661.5	1.5	230
1662	2	370
1662.5	2.5	530
1663	3	720
1664	4	1180
1665	5	1740
1670	10	6240

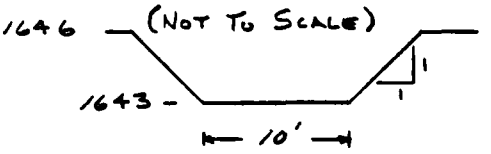


*VALUES ROUNDED TO NEAREST 10 cfs.

B = 39'
Z = 4
C' = 0.95

DISCHARGE RATING CURVE (KEHLY RUN NO. 4)

ELEV (FT)	h.p (FT)	*Q (cfs)
1643	0	0
1643.5	.5	10
1644	1	30
1644.5	1.5	60
1645	2	90
1645.5	2.5	140
1646	3	180
1648	5	440
1650	7	810
1660	17	4563



*VALUES ROUNDED TO NEAREST 10 cfs.

B = 10'
Z = 1
C' = 0.95

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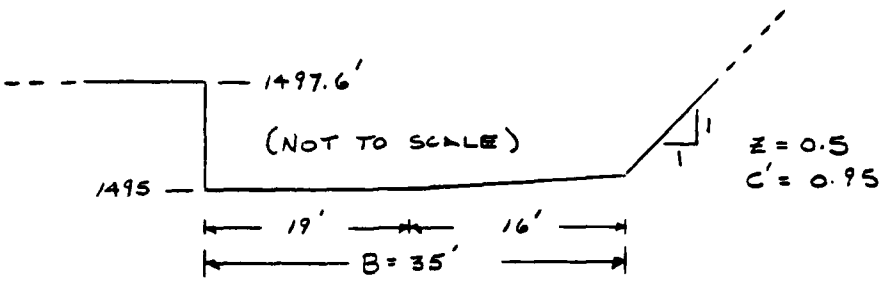
DAM NAME KEHLY RUN No. 3
I.D. NUMBER 54-17
SHEET NO. 4 OF 6
BY OTM DATE 1-24-80

DISCHARGE RATING CURVE (KEHLY RUN No. 3)



ELEV. (FT.)	h_p (FT.)	* Q (cfs)
1495	0	0
1495.5	.5	40
1496	1	100
1496.5	1.5	190
1497	2	300
1497.5	2.5	420
1498	3	550
1500	5	1200
1505	10	3560
1510	15	6840

* VALUES ROUNDED TO NEAREST 10 cfs.

FROM: $Q = 8.03\, C'\, h_v^{1/2} (h_p - h_v) \left[B + z(h_p - h_v)\right]$

WHERE $h_v = \dfrac{3(2z h_p + B) - (16 z^2 h_p^2 + 16 z B h_p + 9 B^2)^{1/2}}{10 z}$

SOURCE: 'WATER & WASTEWATER ENGINEERING
by FAIR, GEYER & OKUM 1966 p.(11-14) & (11-15)

LOW DAMS
by NATIONAL RESOURCES COMMITTEE WASH. DC.
1938 Eq. (7) & (8)

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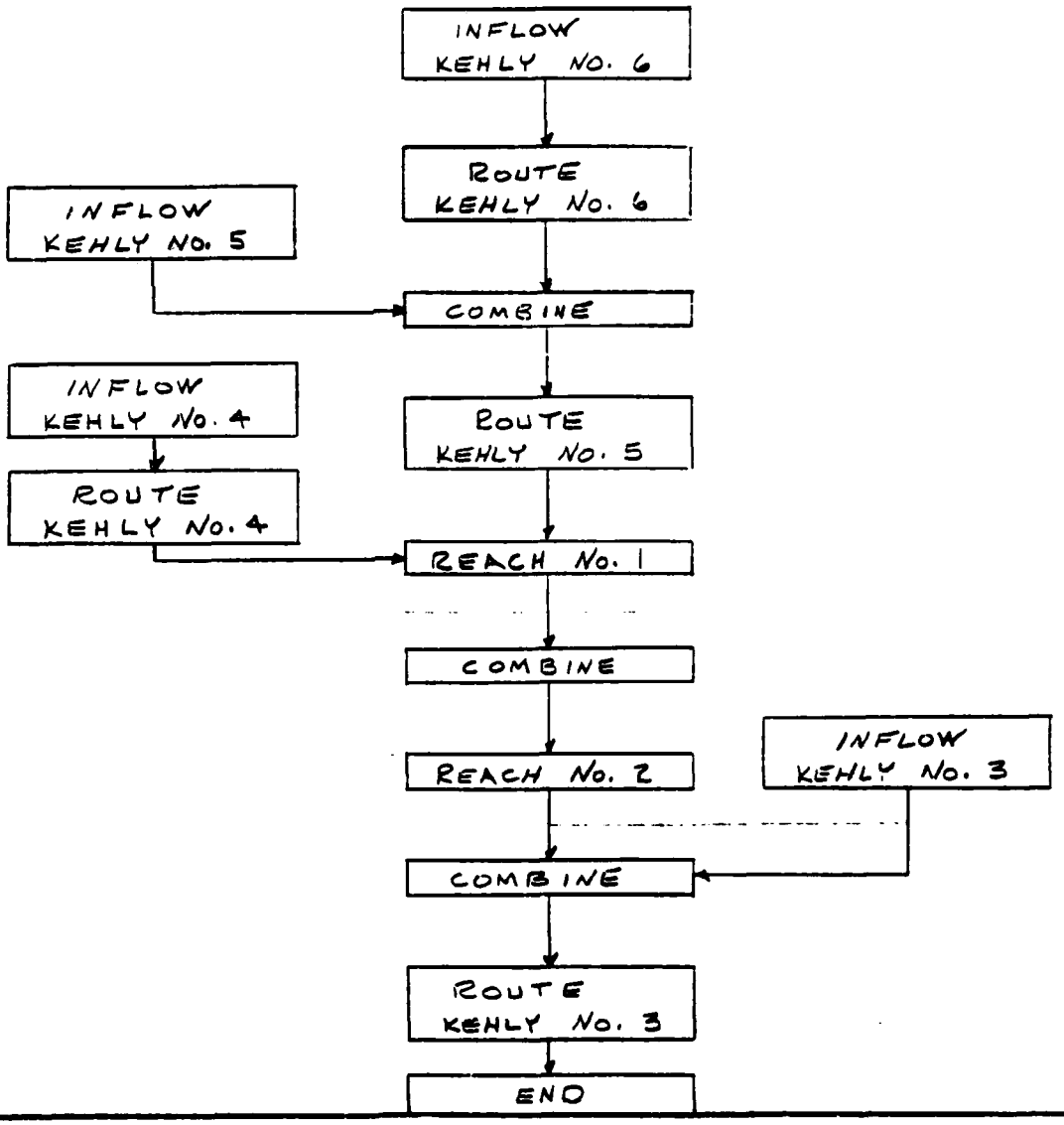
DAM NAME KEHLY RUN No. 3
I.D. NUMBER 54-17
SHEET NO. 5 OF 6
BY OTM DATE 1-24-80

OVERTOP PARAMETERS

TOP OF DAM ELEV. (LOW SPOT) = 1497.6'
LENGTH OF DAM (EXCLUDING SPILLWAY) = 442'
COEFFICIENT OF DISCHARGE (C) = 3.0 (BROAD CREST)
L_{MAX} = N/A } ASSUMED ENTIRE CREST
V_{MAX} = N/A } ELEV. 1497.6'

PROGRAM SCHEDULE - UPSTREAM DAM CONSIDERATION



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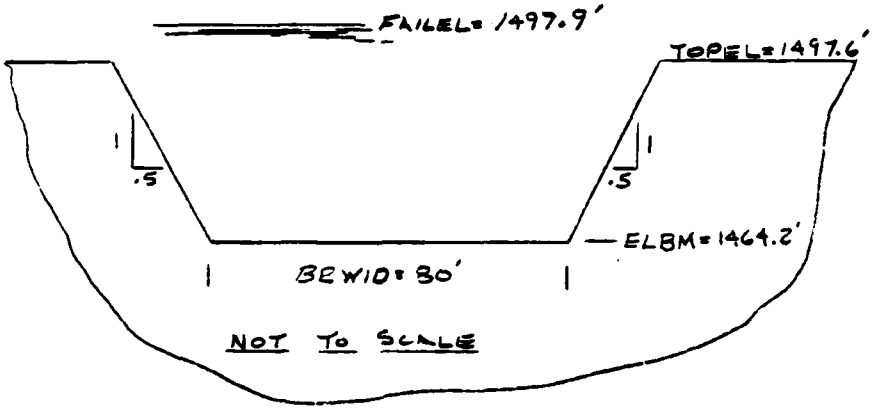
EBENSBURG PENNSYLVANIA

DAM NAME KEHLY RUN DAM NO. 3
I.D. NUMBER 54-17
SHEET NO. 6 OF 6
BY OTM DATE 1-80

DAM BREACH PARAMETERS



RATIO OF PMF (RTIO) = 0.30
SIDE SLOPE OF BREACH (Z) = 0.5
FAILURE TIME (TFAIL) = 2 HRS.

CHANNEL ROUTING

CHANNEL CROSS SECTIONS OBTAINED FROM U.S.G.S. QUAD.

CHANNEL MANNING'S n, QN(2) = 0.05

OVERBANK MANNING'S n, QN(1) = 0.06

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION  JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
    1     A1    ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
    2     A2    HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF KEHLY RUN NO. 3
    3     A3    RATIOS OF PMF ROUTED THROUGH THE RESERVOIR  PA. 54-19
    4     B   288     0    15     0     0     0     0     0     0     0
    5     B1   5
    6     J    1     6     1
    7     J1  .1    .3    .5    .7    .9     1
    8     K    0     1                                  1
    9     K1     INFLOW TO RESERVOIR NO. 6
   10     M    1     1   0.29                                          1
   11     P          22.3   117   127   136   143   145
   12     T                                          1.0   0.05
   13     W  0.87  0.50
   14     X  -1.5  -.05   2.0
   15     K    1     2                                  1
   16     K1     ROUTE THRU KEHLY RESERVOIR NO. 6
   17     Y                          1     1
   18     Y1   1                                      -1675    -1
   19     Y4 1675  1676  1677  1678  1678.5  1679  1680  1685  1690
   20     Y5    0   110   310   570   730   900  1280  3940  7830
   21     SA    0    21    46    92
   22     SE 1669  1675  1680  1700
   23     SS 1675
   24     SD1678.5   3.0   1.5  1200
   25     K    0     3                                  1
   26     K1     INFLOW TO RESERVOIR NO. 5
   27     M    1     1   0.11                                          1
   28     P          22.3   117   127   136   143   145
   29     T                                          1.0   .05
   30     W  0.87  0.50
   31     X  -1.5  -.05   2.0
   32     K    2     4                                  1
   33     K1     COMBINE
   34     K    1     5                                  1
   35     K1     ROUTE THRU RESERVOIR NO. 5
   36     Y                          1     1
   37     Y1   1                                      -1660    -1
   38     Y4 1660  1660.5  1661  1661.5  1662  1662.5  1663  1664  1665  1670
   39     Y5    0    40   120   230   370   530   720  1180  1740  6240
   40     SA    0     8    23
   41     SE1639.7  1660  1680
   42     SS 1660
   43     SD1663.1   3.0   1.5  1150
   44     K    1     6                                  1
   45     K1     CHANNEL ROUTING - MUD PULS REACH 1
   46     Y                          1     1
   47     Y1   1
   48     Y6  .06   .05   .06  1618  1660   850  0.0471
   49     Y7   0  1660   350  1640   600  1620   601  1618   604  1618
   50     Y7 605  1620   850  1640  1100  1660
```

```
K      0       7                                                                1
K1       INFLOW TO RESERVOIR NO. 4
M      1       1     0.04                                                                       1
P              22.3     117      127      136      143      145
T                                                                 1.0     0.05
W    0.56     0.50
X    -1.5      -.05     2.0
K      1       8                                                                1
K1       ROUTE THRU RESERVOIR NO. 4
Y                                                  1        1
Y1     1                                                                 -1643      -1
Y6  1643  1643.5     1644  1644.5     1645  1645.5     1646     1648     1650     1660
Y5     0      10       30       60       90      140      180      440      810     4563
SA     0     1.3      6.6
SE1614.6     1643     1660
SS  1643
SD  1646      3.0      1.5      450
K      2       9                                                                1
K1       COMBINE
K      1      10                                                                1
K1       CHANNEL  ROUTING - MOD PULS REACH 2
Y                                                  1        1
Y1     1
Y6   .06      .05      .08     1498     1540     1600   0.0750
Y7     0    1540       90     1520      200     1800      201     1498      204     1498
Y7   205    1500      350     1520      390     1540
K      0      11                                                                1
K1       INFLOW TO RESERVOIR NO. 3
M      1       1     0.57                                                                       1
P              22.3     117      127      136      143      145
T                                                                 1.0     0.05
W    1.34     0.50
X    -1.5      -.05     2.0
K      2      12                                                                1
K1       COMBINE
K      1      13                                                                1
K1       ROUTE THRU RESERVOIR NO. 3
Y                                                  1        1
Y1     1                                                                 -1495      -1
Y4  1495  1495.5     1496  1496.5     1497  1497.5     1498     1500     1505     1510
Y5     0      40      100      190      300      420      550     1200     3560     6840
SA     0     2.4      3.7      6.4
SE1453.5     1495     1500     1520
SS  1495
SD1497.6      3.0      1.5      442
K     99
```

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

 RUN  DATE= 80/01/24.
      TIME= 05.35.34.
```

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF KEHLY RUN NO. 3
RATIOS OF PMF ROUTED THROUGH THE RESERVOIR PA. 54-19

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	15	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 6 LRTIO= 1

RTIOS= .10 .30 .50 .70 .90 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR NO. 6

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.29	0.00	.29	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.30	117.00	127.00	136.00	143.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS- .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= .87 CP= .50 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 3.67 AND R= 4.76 INTERVALS

UNIT HYDROGRAPH 28 END-OF-PERIOD ORDINATES. LAG= .87 HOURS. CP= .50 VOL= 1.00

14.	52.	91.	105.	93.	75.	61.	49.	40.	3..
26.	21.	17.	14.	11.	9.	7.	6.	5.	4.

HYDROGRAPH ROUTING

ROUTE THRU KEHLY RESERVOIR NO. 6

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1675.	-1

STAGE	1675.00	1676.00	1677.00	1678.00	1678.50	1679.00	1680.00	1685.00	1690.00
FLOW	0.00	110.00	310.00	570.00	730.00	900.00	1280.00	3940.00	7830.00
SURFACE AREA=	0.	21.	46.	92.					
CAPACITY=	0.	42.	205.	1559.					
ELEVATION=	1669.	1675.	1680.	1700.					

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1675.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1678.5	3.0	1.5	1200.

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR NO. 5

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.11	0.00	.11	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.30	117.00	127.00	136.00	143.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM, IS .800

LOSS DATA

CROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= .87 CP= .50 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 3.67 AND R= 4.76 INTERVALS

UNIT HYDROGRAPH 28 END-OF-PERIOD ORDINATES, LAG= .87 HOURS, CP= .50 VOL= 1.00

5.	20.	34.	40.	35.	28.	23.	19.	15.	12.
10.	8.	6.	5.	4.	3.	3.	2.	2.	1.
1.	1.	1.	1.	1.	0.	0.	0.		

END-OF-PERIOD FLOW

HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR NO. 5

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1660.	-1

STAGE	1660.00	1660.50	1661.00	1661.50	1662.00	1662.50	1663.00	1664.00	1665.00
1670.00									
FLOW	0.00	48.00	120.00	230.00	370.00	530.00	720.00	1180.00	1740.00
6240.00									
SURFACE AREA=	0.	8.	23.						
CAPACITY=	0.	54.	351.						
ELEVATION=	1640.	1660.	1680.						

CREL	SPWID	COQW	EXPW	ELEVI	COQL	CAREA	EXPL
1660.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1663.1	3.0	1.5	1150.

HYDROGRAPH ROUTING

CHANNEL ROUTING - MOD PUL'S REACH 1

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0600	.0500	.0600	1618.0	1660.0	850.	.04710

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 1660.00 350.00 1640.00 600.00 1620.00 601.00 1618.00 604.00 1618.00
605.00 1620.00 850.00 1640.00 1100.00 1660.00

STORAGE	0.00	.19	1.81	5.79	12.13	20.83	31.89	45.31	61.09
	99.73	122.86	148.86	177.71	209.43	244.00	281.44	321.74	364.89
OUTFLOW	0.00	67.19	694.61	3020.89	7939.39	16199.05	28470.22	45370.36	67477.72
	129388.25	168673.32	215815.92	271392.95	335972.05	410108.72	494345.67	589213.05	695229.08
STAGE	1618.00	1620.21	1622.42	1624.63	1626.84	1629.05	1631.26	1633.47	1635.68
	1640.11	1642.32	1644.53	1646.74	1648.95	1651.16	1653.37	1655.58	1657.79
FLOW	0.00	67.19	694.61	3020.89	7939.39	16199.05	28470.22	45370.36	67477.72
	129388.25	168673.32	215815.92	271392.95	335972.05	410108.72	494345.67	589213.05	695229.08

SUB-AREA RUNOFF COMPUTATION

8/17

INFLOW TO RESERVOIR NO. 4

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
7	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.04	0.00	.04	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.30	117.00	127.00	136.00	143.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= .56 CP= .50 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 2.35 AND R= 3.03 INTERVALS

UNIT HYDROGRAPH 18 END-OF-PERIOD ORDINATES. LAG= .56 HOURS. CP= .50 VOL= 1.00

6. 18. 21. 17. 12. 9. 6. 4. 3. 2.

HYDROGRAPH ROUTING

9/17

ROUTE THRU RESERVOIR NO. 4

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
8	1	0	0	0	0	1	0	0

ROUTING DATA:

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1643.	-1

STAGE	1643.00	1643.50	1644.00	1644.50	1645.00	1645.50	1646.00	1648.00	1650.00	1660.00
FLOW	0.00	10.00	30.00	60.00	90.00	140.00	180.00	440.00	810.00	4563.00
SURFACE AREA=	0.	1.	7.							
CAPACITY=	0.	12.	74.							
ELEVATION=	1615.	1643.	1660.							

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1643.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1660.0	3.0	1.5	450.

HYDROGRAPH ROUTING

CHANNEL ROUTING - MOD PULS REACH 2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
10	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0600	.0500	.0600	1498.0	1540.0	1600.	.07500

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 1540.00 90.00 1520.00 200.00 1500.00 201.00 1498.00 204.00 1498.00
205.00 1500.00 350.00 1520.00 390.00 1540.00

STORAGE	0.00	.34	2.11	6.17	12.51	21.15	32.07	45.28	60.78
	78.56	98.64	120.39	143.30	167.39	192.64	219.05	246.63	275.38
	305.30	336.38							
OUTFLOW	0.00	84.39	603.70	2273.33	5663.02	11252.24	19471.04	30716.07	45359.13
	63752.48	86364.10	115821.44	149424.58	187209.00	229227.01	275542.52	326227.59	381360.18
	441022.59	505300.30							
STAGE	1498.00	1500.21	1502.42	1504.63	1506.84	1509.05	1511.26	1513.47	1515.68
	1517.89	1520.11	1522.32	1524.53	1526.74	1528.95	1531.16	1533.37	1535.58
	1537.79	1540.00							
FLOW	0.00	84.39	603.70	2273.33	5663.02	11252.24	19471.04	30716.07	45359.13
	63752.48	86364.10	115821.44	149424.58	187209.00	229227.01	275542.52	326227.59	381360.18
	441022.59	505300.30							

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR NO. 3

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
11	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.57	0.00	.57	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.30	117.00	127.00	136.00	141.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 1.34 CP= .50 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 5.89 AND R= 7.21 INTERVALS

HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR NO. 3

	ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	13	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.000	0.00	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1495.	-1

STAGE	1495.00	1495.50	1496.00	1496.50	1497.00	1497.50	1498.00	1500.00	1505.00
1510.00									
FLOW	0.00	40.00	100.00	190.00	300.00	420.00	550.00	1200.00	3560.00
6840.00									
SURFACE AREA=	0.	2.	4.	6.					
CAPACITY=	0.	33.	48.	148.					
ELEVATION=	1454.	1495.	1500.	1520.					

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1495.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1497.6	3.0	1.5	442.

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PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .10	RATIO 2 .30	RATIO 3 .50	RATIO 4 .70	RATIO 5 .90	RATIO 6 1.00
HYDROGRAPH AT	1	.29	1	102.	306.	511.	715.	919.	1021.
		.75)		2.89)	8.67)	14.46)	20.24)	26.02)	28.92)
ROUTED TO	2	.29	1	60.	199.	344.	493.	641.	717.
		.75)		1.71)	5.64)	9.75)	13.95)	18.18)	20.29)
HYDROGRAPH AT	3	.11	1	39.	116.	194.	271.	349.	387.
		.28)		1.10)	3.29)	5.48)	7.68)	9.87)	10.97)
2 COMBINED	4	.40	1	87.	282.	486.	697.	904.	1012.
		1.04)		2.47)	7.99)	13.79)	19.73)	25.61)	28.64)
ROUTED TO	5	.40	1	84.	276.	478.	687.	906.	1012.
		1.04)		2.37)	7.82)	13.54)	19.45)	25.66)	28.67)
ROUTED TO	6	.40	1	84.	276.	478.	687.	905.	1015.
		1.04)		2.37)	7.82)	13.54)	19.44)	25.62)	28.74)
HYDROGRAPH AT	7	.04	1	18.	53.	88.	123.	158.	175.
		.10)		.50)	1.49)	2.48)	3.47)	4.46)	4.96)
ROUTED TO	8	.04	1	14.	46.	78.	112.	145.	160.
		.10)		.40)	1.32)	2.20)	3.18)	4.10)	4.53)
2 COMBINED	9	.44	1	93.	305.	529.	762.	1020.	1139.
		1.14)		2.63)	8.63)	14.97)	21.56)	28.87)	32.25)
ROUTED TO	10	.44	1	93.	305.	528.	761.	1017.	1149.
		1.14)		2.63)	8.63)	14.95)	21.55)	28.81)	32.54)
HYDROGRAPH AT	11	.57	1	161.	484.	807.	1130.	1453.	1615.
		1.48)		4.57)	13.72)	22.86)	32.01)	41.15)	45.72)
2 COMBINED	12	1.01	1	246.	769.	1314.	1866.	2471.	2764.
		2.62)		6.97)	21.78)	37.22)	52.84)	69.96)	78.26)
ROUTED TO	13	1.01	1	245.	769.	1315.	1866.	2469.	2767.
		2.62)		6.93)	21.78)	37.24)	52.83)	69.91)	78.36)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ••••••••••••••••

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1675.00	1675.00	1678.50
STORAGE	42.	42.	143.
OUTFLOW	0.	0.	730.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	1675.55	0.00	54.	60.	0.00	42.25	0.00
.30	1676.45	0.00	77.	199.	0.00	42.00	0.00
.50	1677.13	0.00	97.	344.	0.00	41.75	0.00
.70	1677.70	0.00	115.	493.	0.00	41.75	0.00
.90	1678.22	0.00	133.	641.	0.00	41.75	0.00
1.00	1678.46	0.00	141.	717.	0.00	41.75	0.00

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SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1660.00	1660.00	1663.10
STORAGE	54.	54.	82.
OUTFLOW	0.	0.	766.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	1660.77	0.00	60.	84.	0.00	42.25	0.00
.30	1661.66	0.00	68.	276.	0.00	41.75	0.00
.50	1662.34	0.00	74.	478.	0.00	41.75	0.00
.70	1662.91	0.00	80.	687.	0.00	41.50	0.00
.90	1663.19	.09	83.	906.	2.00	41.00	0.00
1.00	1663.24	.14	85.	1012.	2.75	41.25	0.00

PLAN 1 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	84.	1620.3	42.25
.30	276.	1620.9	42.00
.50	478.	1621.7	41.75
.70	687.	1622.4	41.50
.90	905.	1622.6	41.25
1.00	1015.	1622.7	41.50

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1643.00	1643.00	1646.00
STORAGE	12.	12.	17.
OUTFLOW	0.	0.	180.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	1643.60	0.00	13.	14.	0.00	40.75	0.00
.30	1644.27	0.00	14.	46.	0.00	40.50	0.00
.50	1644.79	0.00	15.	78.	0.00	40.50	0.00
.70	1645.22	0.00	16.	112.	0.00	40.50	0.00
.90	1645.56	0.00	16.	145.	0.00	40.50	0.00
1.00	1645.75	0.00	17.	160.	0.00	40.50	0.00

PLAN 1 STATION 10

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	93.	1500.2	42.00
.30	305.	1501.1	41.75
.50	528.	1502.1	41.50
.70	761.	1502.6	41.50
.90	1017.	1503.0	41.00
1.00	1149.	1503.1	41.00

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SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ••••••••••••••••

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1495.00	1495.00	1497.60
STORAGE	33.	33.	40.
OUTFLOW	0.	0.	446.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	1496.75	0.00	38.	245.	0.00	41.25	0.00
.30	1497.92	.32	41.	769.	3.50	41.25	0.00
.50	1498.24	.64	42.	1315.	6.00	41.25	0.00
.70	1498.51	.91	43.	1866.	7.50	41.25	0.00
.90	1498.77	1.17	44.	2469.	8.50	41.00	0.00
1.00	1498.88	1.28	44.	2767.	8.75	41.00	0.00

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
    1          A1       RATIO OF PMF ROUTED THROUGH THE RESERVOIR AND DOWNSTREAM
    2          A2       DOWNSTREAM CONDITION DUE TO OVERTOP (KEHLY RUN NO. 3 - 54-19)
    3          A3       PLAN 1 ASSUMES BREACH, PLAN 2 ASSUMES NO BREACH
    4          B   288       0      15       0       0       0       0       0       0       0
    5          B1    5
    6          J     2       1       1
    7          J1   .3
    8          K     0       1                                               1
    9          K1       INFLOW TO RESERVOIR NO. 6
   10          M     1       1   0.79                                                        1
   11          P                22.3     117     127     136     143     145
   12          T                                                        1.0    0.05
   13          W  0.87    0.50
   14          X -1.5    -.05     2.0
   15          K     1       2                                               1
   16          K1       ROUTE THRU KEHLY RESERVOIR NO. 6
   17          Y                                        1       1
   18          Y1    1                                                  -1675      -1
   19          Y4 1675    1676    1677    1678  1678.5    1679    1680    1685    1690
   20          Y5    0     110     310     570     730     900    1280    3940    7830
   21          $A    0      21      46      92
   22          $E 1669    1675    1680    1700
   23          $$ 1675
   24          $D1678.5     3.0     1.5    1200
   25          K     0       3
   26          K1       INFLOW TO RESERVOIR NO. 5
   27          M     1       1   0.11                                                        1
   28          P                22.3     117     127     136     143     145
   29          T                                                        1.0    .05
   30          W  0.87    0.50
   31          X -1.5    -.05     2.0
   32          K     2       4                                               1
   33          K1       COMBINE
   34          P     1       5                                               1
   35          K1       ROUTE THRU RESERVOIR NO. 5
   36          Y                                        1       1
   37          Y1    1                                                  -1660      -1
   38          Y4 1660  1660.5    1661  1661.5    1662  1662.5    1663    1664    1665    1670
   39          Y5    0      40     120     230     370     530     720    1180    1740    6240
   40          $A    0       8      23
   41          $L1639.7    1660    1680
   42          $$ 1660
   43          $D1643.1     3.0     1.5    1150
   44          K     1       6                                               1
   45          K1       CHANNEL ROUTING - MOD PULS REACH 1
   46          Y                                        1       1
   47          Y1    1
   48          Y6  .06     .05     .06    1618    1660     850  0.0471
   49          Y7    0    1660     350    1640     600    1620     601    1618     604    1618
   50          Y7  605    1620     850    1640    1100    1660
```

```
K     0       7                                                   1
K1        INFLOW TO RESERVOIR NO. 4
M     1       1     0.04                                                        1
P           22.3     117      127      136      143      145
T                                                              1.0     0.05
W   0.56    0.50
X   -1.5    -.05     2.0
K     1       8                                                   1
K1        ROUTE THRU RESERVOIR NO. 4
Y                                          1        1
Y1    1                                                         -1643     -1
Y6  1643  1643.5     1644   1644.5     1645   1645.5     1646     1648     1650     1660
Y8    0      10       30       60       90      140      180      440      810     4563
$A    0     1.3      6.6
$E1614.6    1643     1660
$$  1643
$D  1646     3.0      1.5      450
K     2       9                                                   1
K1        COMBINE
K     1      10                                                   1
K1        CHANNEL  ROUTING - MOD PULS REACH 7
Y                                          1        1
Y1    1
Y6   .06     .09      .06     1498     1540     1600   0.0750
Y7    0    1540       90     1520      200     1500      201     1498      204     1498
Y7  205    1500      350     1520      390     1540
K     0      11                                                   1
K1        INFLOW TO RESERVOIR NO. 3
M     1       1     0.57                                                        1
P           22.3     117      127      136      143      145
T                                                              1.0     0.05
W   1.34    0.50
X   -1.5    -.05     2.0
K     2      12                                                   1
K1        COMBINE
K     1      13                                                   1
K1        ROUTE THRU RESERVOIR NO. 3
Y                                          1        1
Y1    1                                                         -1495     -1
Y4  1495  1495.5     1496   1496.5     1497   1497.5     1498     1500     1505     1510
Y5    0      40      100      190      300      420      550     1200     2560     6840
$A    0     2.4      3.7      6.4
$E1453.5    1495     1500     1520
$$  1495
$D1497.6     3.0      1.5      442
$B    80      .5   1464.2        2     1495   1497.9
$B    80      .5   1464.2        2     1495     1505
K     1      14                                                   1
K1        CHANNEL ROUTING  MOD-PULS REACH NO 1
Y                                          1        1
```

```
101        Y3    1
102        Y6   .06   .05   .06  1379  1400  1600 0.0400
103        Y7    0   1400    40  1390    80  1380    82  1379    85  1379
104        Y7   87   1380   100  1390   120  1400
105        K    99
```

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

RUN DATE= 80/01/28.
TIME= 10.48.21.

RATIO OF PMF ROUTED THROUGH THE RESERVOIR AND DOWNSTREAM
DOWNSTREAM CONDITION DUE TO OVERTOP (KEHLY RUN NO. 3 - 54-19)
PLAN 1 ASSUMES BREACH, PLAN 2 ASSUMES NO BREACH

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
269	0	15	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 2 NRTIO= 1 LRTIO= 1

RTIOS= .30

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR NO. 6

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.29	0.00	.29	0.00	0.000	0	1	0

PRECIP DATA

SPFE	RMS	R6	R12	R24	R48	R72	R96
0.00	22.30	117.00	127.00	136.00	143.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= .87 CP= .50 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 3.67 AND R= 4.16 INTERVALS

UNIT HYDROGRAPH 28 END-OF-PERIOD ORDINATES, LAG= .87 HOURS, CP= .50 VOL= 1.00

14.	52.	91.	105.	93.	75.	61.	49.	40.	32.
26.	21.	17.	14.	11.	9.	7.	6.	5.	4.

HYDROGRAPH ROUTING

5/19

ROUTE THRU KEHLY RESERVOIR NO. 6

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	-0.000	0.000	-1675.	-1

STAGE	1675.00	1676.00	1677.00	1678.00	1678.50	1679.00	1680.00	1685.00	1690.00
FLOW	0.00	110.00	310.00	570.00	730.00	900.00	1280.00	3940.00	7830.00
SURFACE AREA=	0.	21.	46.	92.					
CAPACITY=	0.	42.	205.	1559.					
ELEVATION=	1669.	1675.	1680.	1700.					

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1675.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1678.5	3.0	1.5	1200.

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR NO. 5

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	0	0	0	0	0	0	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.11	0.00	.11	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.30	117.00	127.00	136.00	143.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

16

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOR	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= .87 CP= .50 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 3.67 AND R= 4.76 INTERVALS

UNIT HYDROGRAPH 28 END-OF-PERIOD ORDINATES, LAG= .87 HOURS, CP= .50 VOL= 1.00

5.	20.	34.	40.	35.	28.	23.	19.	15.	12.
10.	8.	6.	5.	4.	3.	3.	2.	2.	1.
1.	1.	1.	1.	1.	0.	0.	0.		

HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR NO. 5

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1660.	-1

STAGE	1660.00	1660.50	1661.00	1661.50	1662.00	1662.50	1663.00	1664.00	1665.00
1670.00									
FLOW	0.00	40.00	120.00	230.00	370.00	530.00	720.00	1180.00	1740.00
6240.00									
SURFACE AREA=	0.	8.	23.						
CAPACITY=	0.	54.	351.						
ELEVATION=	1640.	1660.	1680.						

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1660.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1663.1	3.0	1.5	1150.

STATION 5. PLAN 1. RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

HYDROGRAPH ROUTING

CHANNEL ROUTING - MOD PULS REACH-1

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0600	.0500	.0600	1618.0	1660.0	850.	.04710

D-35

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 1660.00 350.00 1640.00 500.00 1620.00 601.00 1618.00 604.00 1618.00
605.00 1620.00 850.00 1640.00 1100.00 1660.00

STORAGE	0.00	.19	1.81	9.79	12.13	20.83	31.89	45.31	61.09
776279.23	99.73	122.86	148.86	177.71	209.43	244.00	281.44	321.74	364.89
776410.91									
OUTFLOW	0.00	67.19	694.61	3020.89	7939.39	16199.05	28470.22	45370.36	67477.72
95339.84	129388.25	168673.32	215815.92	271392.95	335972.05	410108.72	494345.67	589213.05	695229.08
812900.73									
STAGE	1618.00	1620.21	1622.42	1624.63	1626.84	1629.05	1631.26	1633.47	1635.68
1637.89	1640.11	1642.32	1644.53	1646.74	1648.95	1651.16	1653.37	1655.58	1657.79
1660.00									
FLOW	0.00	67.19	694.61	3020.89	7939.39	16199.05	28470.22	45370.36	67477.72
95339.84	129388.25	168673.32	215815.92	271392.95	335972.05	410108.72	494345.67	589213.05	695229.08
812900.73									

9/19

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR NO. 4

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
7	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.04	0.00	.04	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.30	117.00	127.00	136.00	143.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= .50 CP= .50 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 2.35 AND R= 3.03 INTERVALS

UNIT HYDROGRAPH 18 END-OF-PERIOD ORDINATES, LAG= .56 HOURS, CP= .50 VOL= 1.00

6.	18.	21.	17.	12.	9.	6.	4.	3.	2.
2.	1.	1.	1.	0.	0.	0.	0.		

HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR NO. 4

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
8	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1645.	-1

STAGE	1643.00	1643.50	1644.00	1644.50	1645.00	1645.50	1646.00	1648.00	1650.00
//1660.00									
FLOW	0.00	10.00	30.00	60.00	90.00	140.00	180.00	440.00	810.00
14563.00									
SURFACE AREA=	0.	1.	7.						
CAPACITY=	0.	12.	74.						
ELEVATION=	1615.	1643.	1660.						

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1643.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1666.0	3.0	1.5	450.

HYDROGRAPH ROUTING

CHANNEL ROUTING - MOD PUL'S REACH 2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
10	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

UNITI	UNIT2	UNIT3	ELMVT	ELMAX	RLNTH	SEL
.0600	.0500	.0500	1499.0	1540.0	1600.	.07500

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 1540.00 90.00 1520.00 200.00 1500.00 201.00 1498.00 204.00 1498.00
205.00 1500.00 350.00 1520.00 390.00 1540.00

STORAGE	0.00	.34	2.11	6.17	12.51	21.15	32.07	45.28	60.78
//1678.56	98.64	120.39	143.30	167.39	192.64	219.05	246.63	275.38	305.30
//1336.38									
OUTFLOW	0.00	84.39	603.70	2273.33	5663.02	11252.24	19471.04	30716.07	45359.13
863752.48	86364.10	115821.44	149424.58	187209.00	229227.01	275542.52	326227.59	381360.18	441022.59
505300.30									
STAGE	1498.00	1500.21	1502.42	1504.63	1506.84	1509.05	1511.26	1513.47	1515.68
//1517.89	1520.11	1522.32	1524.53	1526.74	1528.95	1531.16	1533.37	1535.58	1537.79
//1540.00									
FLOW	0.00	84.39	603.70	2273.33	5663.02	11252.24	19471.04	30716.07	45359.13
863752.48	86364.10	115821.44	149424.58	187209.00	229227.01	275542.52	326227.59	381360.18	441022.59
505300.30									

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR NO. 3

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
11	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.57	0.00	.57	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.30	117.00	127.00	136.00	143.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 1.34 CP= .50 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 5.89 AND R= 7.21 INTERVALS

UNIT HYDROGRAPH 42 END-OF-PERIOD ORDINATES. LAG= 1.34 HOURS. CP= .50 VOL= 1.00

9.	35.	70.	105.	130.	138.	128.	111.	97.	84.
73.	64.	55.	48.	42.	37.	32.	28.	24.	21.
18.	16.	14.	12.	10.	9.	8.	7.	6.	5.
5.	4.	3.	3.	3.	2.	2.	2.	1.	1.
1.	1.								

HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR NO. 3

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
13	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	3	0	0.000	0.000	0.000	-1495.	-1

STAGE	1495.00	1495.50	1496.00	1496.50	1497.00	1497.50	1498.00	1500.00	1505.00
1501510.00									
FLOW	0.00	40.00	100.00	190.00	300.00	420.00	550.00	1200.00	3560.00
1736840.00									
SURFACE AREA=	0.	2.	4.	6.					
CAPACITY=	0.	33.	48.	148.					
ELEVATIONS=	1454.	1495.	1500.	1920.					

CREL	SPWID	COGW	EAPW	ELEVL	COOL	CAREA	EXPL
1495.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1497.6	3.0	1.5	442.

DAM BREACH DATA

BRWID	Z	FLHM	TRAIL	WSEL	FAILEL
80.	.50	1464.20	2.00	1495.00	1497.90

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .30
HYDROGRAPH AT	1	.29	1	306.
		(.75)		(8.67)
			2	306.
				(8.67)
ROUTED TO	2	.29	1	199.
		(.75)		(5.64)
			2	199.
				(5.64)
HYDROGRAPH AT	3	.11	1	116.
		(.28)		(3.29)
			2	116.
				(3.29)
2 COMBINED	4	.40	1	282.
		(1.04)		(7.99)
			2	282.
				(7.99)
ROUTED TO	5	.40	1	276.
		(1.04)		(7.82)
			2	276.
				(7.82)
ROUTED TO	6	.40	1	276.
		(1.04)		(7.82)
			2	276.
				(7.82)
HYDROGRAPH AT	7	.04	1	53.
		(.10)		(1.49)
			2	53.
				(1.49)
ROUTED TO	8	.04	1	46.
		(.10)		(1.32)
			2	46.
				(1.32)
2 COMBINED	9	.44	1	305.
		(1.14)		(8.63)
			2	305.
				(8.63)
ROUTED TO	10	.44	1	305.
		(1.14)		(8.63)

			2	305. (8.63)(
HYDROGRAPH AT	11	.57 (1.48)	1	484. (13.72)(
			2	484. (13.72)(
2 COMBINED	12	1.01 (2.62)	1	769. (21.78)(
			2	769. (21.78)(
ROUTED TO	13	1.01 (2.62)	1	1192. (33.74)(
			2	769. (21.78)(
ROUTED TO	14	1.01 (2.62)	1	1238. (35.07)(
			2	769. (21.76)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ••••••••••••••••

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1675.00	1675.00	1678.50
STORAGE	42.	42.	143.
OUTFLOW	0.	0.	730.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.30	1676.45	0.00	77.	199.	0.00	42.00	0.00

PLAN 2 ••••••••••••••••

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1675.00	1675.00	1678.50
STORAGE	42.	42.	143.
OUTFLOW	0.	0.	730.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.30	1676.45	0.00	77.	199.	0.00	42.00	0.00

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ••••••••••••••••

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1660.00	1660.00	1663.10
STORAGE	54.	54.	82.
OUTFLOW	0.	0.	766.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.30	1661.66	0.00	68.	276.	0.00	41.75	0.00

PLAN 2 ••••••••••••••••

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1660.00	1660.00	1663.10
STORAGE	54.	54.	82.
OUTFLOW	0.	0.	766.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.30	1661.66	0.00	68.	276.	0.00	41.75	0.00

D-47

PLAN 1 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.30	276.	1620.9	42.00

PLAN 2 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.30	276.	1620.9	42.00

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ..... INITIAL VALUE SPILLWAY CREST TOP OF DAM

ELEVATION	1643.00	1643.00	1646.00
STORAGE	12.	12.	17.
OUTFLOW	0.	0.	180.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.30	1644.27	0.00	14.	46.	0.00	40.50	0.00

PLAN 2 ..... INITIAL VALUE SPILLWAY CREST TOP OF DAM

ELEVATION	1643.00	1643.00	1646.00
STORAGE	12.	12.	17.
OUTFLOW	0.	0.	180.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.30	1644.27	0.00	14.	46.	0.00	40.50	0.00

D-40

PLAN 1 STATION 10

RATIO	MAXIMUM FLOW.CFS	MAXIMUM STAGE.FT	TIME HOURS
.30	305.	1501.1	41.75

PLAN 2 STATION 10

RATIO	MAXIMUM FLOW.CFS	MAXIMUM STAGE.FT	TIME HOURS
.30	305.	1501.1	41.75

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	1495.00	1495.00	1497.60
	STORAGE	33.	33.	40.
	OUTFLOW	0.	0.	446.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.30	1497.91	.31	41.	1227.	1.08	41.38	41.00

PLAN 2		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	1495.00	1495.00	1497.60
	STORAGE	33.	33.	40.
	OUTFLOW	0.	0.	446.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.30	1497.92	.32	41.	769.	3.50	41.25	0.00

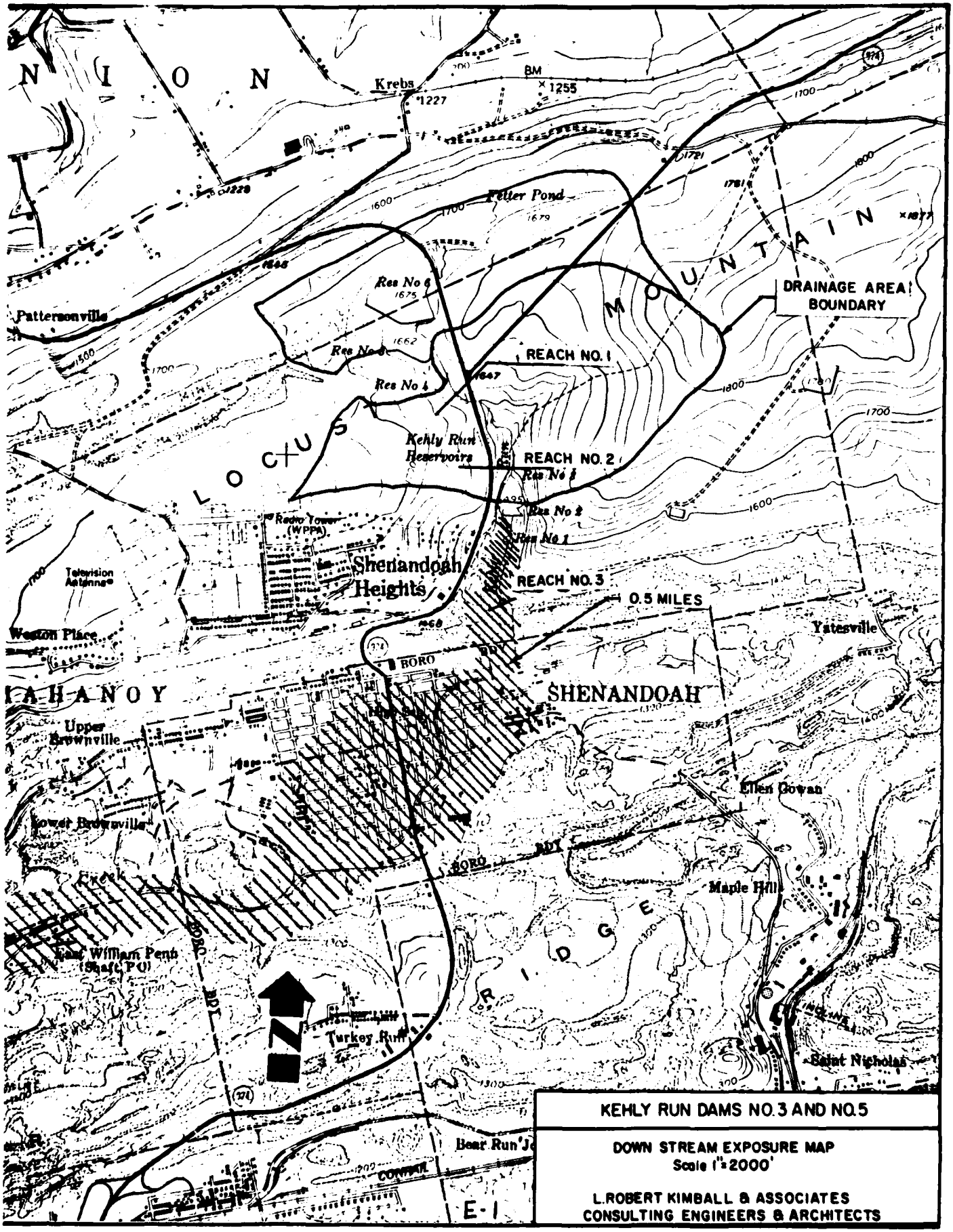
PLAN 1. STATION 14

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.30	1238.	1394.6	41.50

PLAN 2 STATION 14

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.30	769.	1383.6	41.25

APPENDIX E
DRAWINGS



KEHLY RUN DAMS NO.3 AND NO.5

DOWN STREAM EXPOSURE MAP
Scale 1"=2000'

L.ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS

APPENDIX F
GEOLOGY

AD-A083 747 KIMBALL (L ROBERT) AND ASSOCIATES EBENSBURG PA F/G 13/13
NATIONAL DAM INSPECTION PROGRAM, KEHLY RUN DAM NUMBER 3 (NDS ID--ETC(U)
MAR 80 R J KIMBALL DACW31-80-C-0020

UNCLASSIFIED NL

2 OF 2
AD
A083747

END
DATE FILMED
6-80
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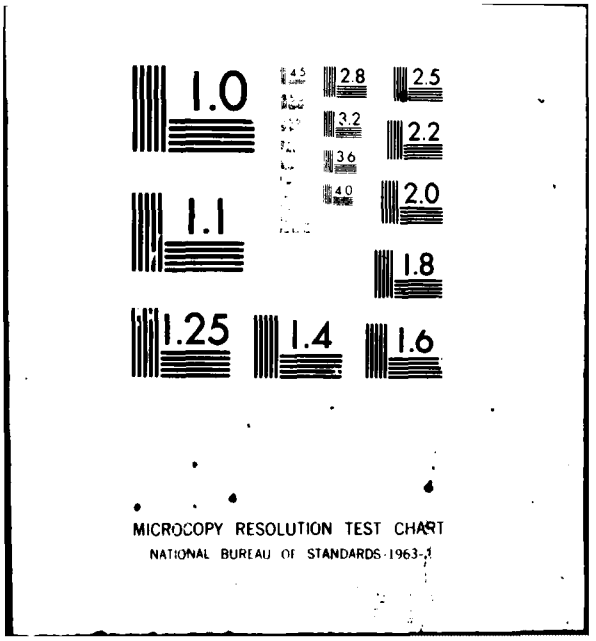
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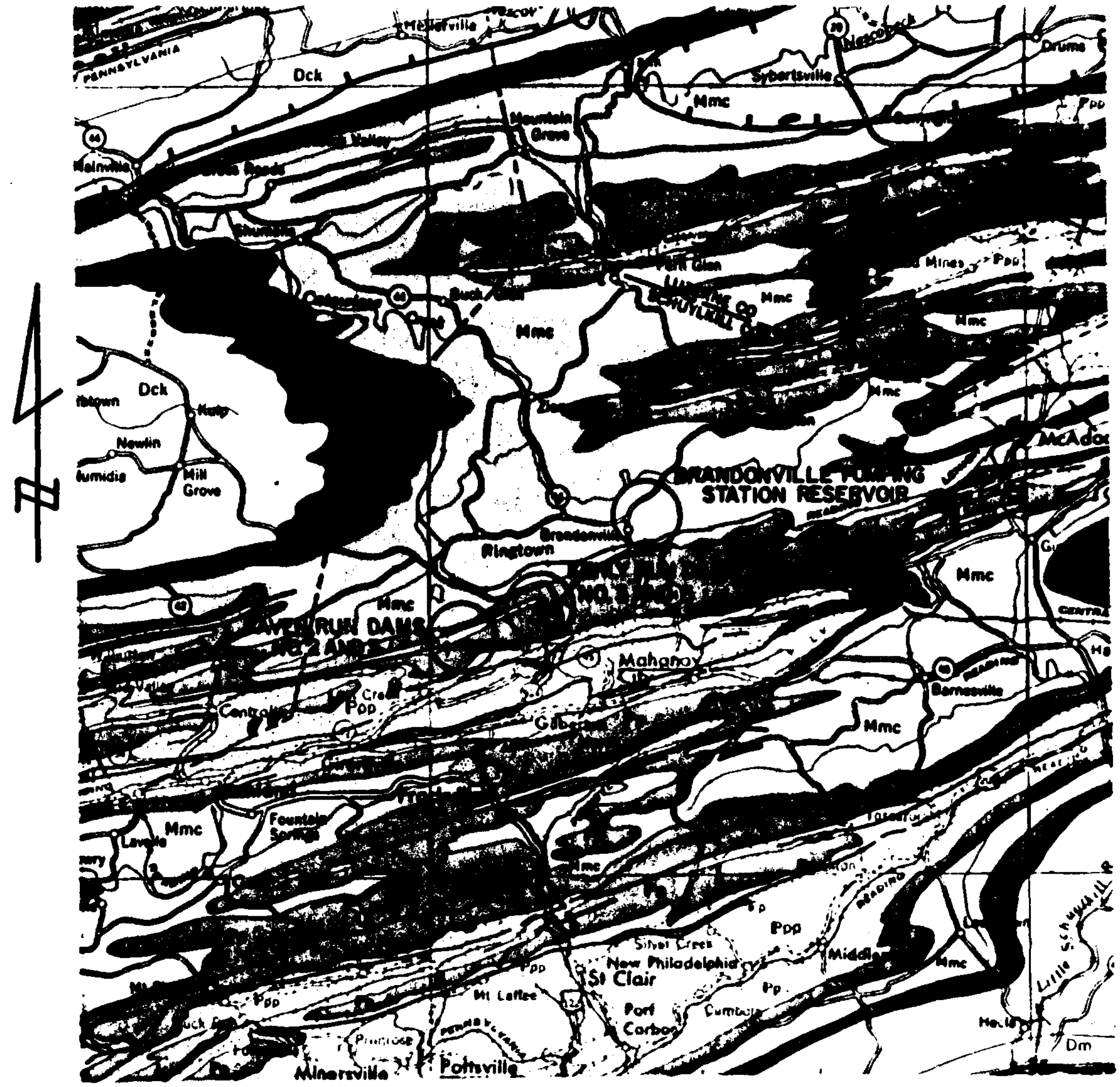
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Kehly Run Dam No. 3 - General Geology

Kehly Run Dam No. 3 is located in the Appalachian Mountain Section of the Valley and Ridge Physiographic Province. This province is typified by numerous synclinal and anticlinal features. Some minor faulting is indicated to the south of the reservoir. The bedrock underlying the dam consists of the Pennsylvanian aged Pottsville Group. This unit consists of light to dark gray, fine grained to conglomeratic sandstone, with lesser amounts of shale, siltstone, limestone, coal and underclay. The bedding is generally well developed with the sandstones and siltstones often cross-bedded. Joints are usually regular and moderately well formed.

Both deep mining and surface mining of anthracite coal have taken place in the vicinity of this dam. The extent of any deep mining is unknown without extensive research.



GEOLOGIC MAP OF THE AREA SURROUNDING RAVEN RUN DAMS NO. 2 AND 3, KEHLY RUN DAMS NO. 3 AND 5, BRANDONVILLE PUMPING STATION RESERVOIR

Pottsville Group
Predominantly sandstones and conglomerates with thin shales and coals; some coals mineable locally

ANTHRACITE REGION

Ppp — **Post-Pottsville Formations**
Brown or gray sandstones and shales with some conglomerate and numerous mineable coals

Pottsville Group
Light gray to white, coarse grained sandstones and conglomerates with some mineable coal ... Schuylkill and Tumbling Run Formations

MISSISSIPPIAN

Mmc — **Mauch Chunk Formation**

SCALE 1:250,000